SALUTOGENIC EFFECTS OF ADVERSITY

AND THE ROLE OF ADVERSITY FOR SUCCESSFUL AGING

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‘*Adversity is the Mother of Progress*’

Mohandas Karamchad (Mahatma) Ghandi

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ABSTRACT

The traditional psychopathological research of adversity has led to a deficit- and treatment-oriented approach to adversity and its effects. However, even though adversities are distressing, negative experiences in the first place, they also inherit resilience and well-being enhancing opportunities which can foster a more fulfilled life. This thesis synthesizes research on the salutogenic effects of adversity and provides empirical evidence for salutogenic effects of different levels of adversity. A mixed-methods project that consisted of a theoretical study, a quantitative longitudinal survey and qualitative interview study was conducted. Its aims were to review the research on 'optimal' adversity, and to investigate the potential positive psychological effects of severe early-life and 'optimal' later-life adversity for successful aging.

The first study systematically reviewed the literature on a potential 'optimal' level of adversity for human well-being and development using curvilinear analyses. A moderate level of adversity was found to be associated with better outcomes compared to higher and lower levels of adversity. The second study investigated potential age-specific salutogenic effects of 'optimal' adversity in later life. It was found that a specific level of adverse experiences can support successful aging by supporting the maintenance of central resilience resources and satisfaction with life. The third study investigated if a subgroup of the Swiss *Verdingkinder* (former indentured child laborers) was able to age successful not despite, but because of its childhood experiences. Three overall factors emerged that were reported as supportive of successful aging: lightheartedness including effective stress-management, lifelong self-enhancement, and social mindedness. Hence, this study shows that known supportive factors of successful aging can be the result of early-life adversity. Several underlying mechanisms and intervening factors of this relationship were identified.

In sum, this thesis gives further evidence for the salutogenic effects of adversity and provides implications for future research and praxis.

ZUSAMMENFASSUNG

Die traditionell psychopathologische Erforschung von Widrigkeiten hat zu einem primär defizit- und therapieorientierten Zugang zu aversiven Erfahrungen und deren Effekten geführt. Obwohl solche Erlebnisse in erster Linie stressige, negative Erfahrungen sind, beinhalten sie dennoch resilienz- und wohlbefindlichkeitsförderliche Möglichkeiten, die zu einem erfüllteren Leben beitragen können. Diese Dissertation synthetisiert die Forschung zu salutogenetischen Effekten von aversiven Erfahrungen und bietet empirische Belege für salutogenetische Effekte von aversiven Erfahrungen unterschiedlichen Ausmasses. Ein „mixed-method" Projekt wurde durchgeführt, welches aus einer theoretischen Studie als auch einer quantitativen Längsschnitt-Fragebogenstudie und einer qualitativen Interviewstudie bestand. Ziel war es, die bisherige Forschung zu einem ‚optimalen' Ausmass an aversiven Erfahrungen zu rezensieren und potentiell positive Effekte sowohl von schwerwiegenden aversiven Kindheitserfahrungen als auch von einem „optimalen" Ausmass an aversiven Erfahrungen im späteren Leben auf erfolgreiches Altern zu untersuchen. Der Fokus lag dabei auf psychologischen Faktoren und Prozessen.

Die erste Studie bietet einen systematischen Bericht über ein potentiell „optimales" Ausmass an aversiven Erfahrungen für Wohlbefinden und Entwicklung des Menschen. Die Untersuchung hat gezeigt, dass ein moderates Ausmass an aversiven Erfahrungen mit besseren Folgen verbunden ist, als ein vermehrtes und ein verringertes Ausmass solcher. Die zweite Studie hat potentiell altersspezifische Effekte eines „optimalen" Ausmasses an aversiven Erfahrungen im späteren Leben untersucht. Es konnte gezeigt werden, dass sich ein spezifisches Ausmass an aversiven Erfahrungen förderlich auf erfolgreiches Altern auswirken kann, indem die Aufrechterhaltung von zentralen Resilienzressourcen und Lebenszufriedenheit unterstützt wird. Die dritte Studie untersuchte, ob eine Teilgruppe der Schweizer *Verdingkinder* (ehemalige Kinderarbeiter) nicht trotz, sondern unter anderem wegen ihrer

Kindheitserfahrungen erfolgreich gealtert ist. Folgende übergeordnete Faktoren, welche bereits in früheren Untersuchungen eine förderliche Wirkung auf erfolgreiches Altern zeigten, konnten auch im vorliegenden Kontext aversiver Erfahrungen nachgewiesen werden: Leichtherzigkeit inklusive eines effektiven Stressmanagements, lebenslange Weiterentwicklung sowie soziale Gesinnung. Mehrere zugrundeliegende Mechanismen und intervenierende Faktoren dieses Zusammenhangs wurden gefunden.

Diese Dissertation gibt weitere Evidenz für die potentiel salutogenetischen Effekte von aversiven Erfahrungen und bietet Implikationen für die zukünftige Forschung und Praxis.

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ABBREVIATIONS

APA = American Psychiatric Association

COR = Conservation of Resources Theory

CRM = Cumulative Risk Model

ELA = Early-life adversity

SA = Successful aging

SWL = Satisfaction with life

TSM = Transactional Stress Model

VK = Verdingkinder

VSM = Vulnerability-Stress Model

WHO = World Health Organization

1. INTRODUCTION

Of the many consequences adversity can have for human well-being and development, its negative effects have been the most extensively studied. As of today, there exists a broad range of evidence for the deleterious impact of adversity. Especially early-life adversity (ELA), such as emotional and physical neglect and abuse in childhood, has been shown to account for a large variation in the occurrence of pathologies in later life (McLaughlin, Conron, Koenen, & Gilman, 2010; Shonkoff et al., 2012). Also, adversities experienced in later life stages, ranging from daily hassles such as work or interpersonal stressors and critical life events such as fatal disease or war, are known for their various detrimental effects (Almeida, Neupert, Banks, & Serido, 2005; Ghobarah, Huth, & Russett, 2004; Nieuwenhuijsen, Bruinvels, & Frings-Dresen, 2010). It is estimated that approximately 30% of the costs for the healthcare system in westernized countries are due to afflictions caused by such adversities (Nater, Gaab, Rief, & Ehlert, 2006). It has therefore become a central aim of global research endeavors to study the mechanisms that help humans to better withstand and cope with adversity as early in life as possible for a healthy lifelong development and well-being (Masten, 2014).

It is generally accepted that there is a negative linear dose-response relationship between the severity of adverse experiences and well-being (McLaughlin et al., 2010; Rutter, 1979; Sameroff, 2000). Data have been presented in the literature which point to the fact that experiencing no adversity at all should be most beneficial while an increasing severity of adversity is related to increasingly worse outcomes (Appleyard, Egeland, van Dulmen, & Sroufe, 2005; Schilling, Aseltine, & Gore, 2008). It has been suggested that this relation is due to a stress sensitizing effect of adverse experiences: each adversity heightens the vulnerability to future adversity and in turn fosters pathogenesis (McLaughlin et al., 2010). In light of the fact that adversities are a normal part of human life, it could be concluded that human well-being and development are better off when adversity is prevented as much as possible.

However, this traditional psychopathological perspective on adversity is challenged by recent salutogenic perspectives which propose well-being protecting and enhancing effects of adversity. Accordingly, resilience, i.e. the ability to successfully adapt to, withstand and cope with adversity should crucially rely on the experience of adversity (Rutter, 2012; Tedeschi & Moore, 2016; Zimmer-Gembeck & Skinner, 2016). The related research is mainly concerned with the salutogenic effects of two types of adversity: 'optimal' adversity (Liu, 2015; Seery, 2011) and critical, overwhelming life events (Tedeschi & Calhoun, 2004). 'Optimal' adversity states that there is a certain level of adversity that has more advantageous consequences for human well-being and functionality than higher *and* lower levels of adversity. Hence, this level of adversity is hypothesized to be a potential premise for optimal human development and aging (Aldwin, 2007; DiCorcia & Tronick, 2011). Because this level is between no or too low and high levels of adversity, it is often referred to as 'moderate'. Nevertheless, research on overwhelming adversity also shows comparable positive effects to 'optimal' adversity (Tedeschi & Calhoun, 2004). According to these perspectives, experiencing no or too little adversity would have the least positive effects for human well-being and development, if people are able to successfully cope with adversity and its negative effects (Rutter, 2012) and show genuine positive effects in the long-run (Zoellner & Maercker, 2006).

However, there are crucial shortcomings in the literature on the salutogenic effects of adversity. Several theoretical constructs that describe potential psychological salutogenic effects of adversity have been separately introduced such as *steeling* (Rutter, 1987), *thriving* (O'Leary & Ickovics, 1995), or *posttraumatic growth* (Tedeschi & Calhoun, 2004). Therefore, it remains an open question whether there are global and adversity-specific salutogenic effects and underlying processes. Further, it is unclear how 'optimal' adversity can be adequately defined (Liu, 2015; Obradović, 2012). Also, research on resilience-enhancing mechanisms traditionally focuses on childhood and adolescence, because they are viewed as very sensitive

periods for the influence of adversity with life-long consequences (Masten, 2014; Zimmer-Gembeck & Skinner, 2016). But since a pronounced global increase of people in higher age is expected over the next decades, it is of high importance to also study mechanisms that support well-being, i.e. successful aging, in later life (WHO, 2015). It is therefore the question if a certain level of adversity can be considered as 'optimal' for resilience and well-being in this period of life. Finally, just as early-life adversity has been shown to negatively influence human development and well-being up into later life (Danese & McEwen, 2012; Ehlert, 2013; McLaughlin et al., 2010), this also shows the possibility that early-life adversity could have lasting positive effects. But no study so far has investigated this potential relationship and its underlying mechanisms.

Therefore, it is the first aim of this thesis to give a closer description of the 'optimal' level of adversity and its implications for human well-being and development based on the available empirical literature up to date. The second aim is to investigate the function of 'optimal' adversity in later life via a longitudinal quantitative study. The third aim is to examine the potential long-lasting positive effects of severe early-life adversity and underlying mechanisms for successful aging via a qualitative study. Finally, this thesis also wants to give a first synthesis of the different introduced theoretical concepts of the potential salutogenic effects of adversity.

This cumulative thesis presents data from a mixed-method project that resulted in one theoretical and two empirical research articles. The thesis is structured as follows: The next chapter provides the theoretical background. Here, the definition of adversity and its negative as well as positive effects are presented. Central models and concepts for both trajectories are presented. The third chapter provides the central rationales for each study and the fourth chapter presents brief summaries of each study. In the final chapter, the results from all studies are jointly discussed and implications will be given for future research as well as praxis. All research articles are presented in their entirety in the appendix.

2. THEORETICAL BACKGROUND

The traditional psychopathological view on adversity in science and praxis is challenged by recent research endeavors that point to potential salutogenic effects of adverse experiences. In the following, the term *adversity* is defined first which is followed by central psychological theories that explain when a situation is experienced as an adversity, and an overview is given about how coping normatively develops over the lifespan via the confrontation with adversity (chapter 2.1). Second, an insight into the potential negative effects of adversity is given via significant theoretical as well as empirical literature (chapter 2.2). Third, the term *resilience* is introduced because it is related to additional outcomes of an adverse encounter, i.e. the return to one's pre-event status respectively the maintenance of well-being in the face of adversity, and a significant factor that influences the short to long-term consequences of adversity and is itself influenced by adversity (chapter 2.3). Finally, the salutogenic perspective is presented with a focus on what can be considered as positive effects of adversity and what are central antecedents of such effects (chapter 2.4).

2.1 Adversity and coping

Adversity can occur in manifold forms ranging from everyday socio-economic hardships to natural catastrophes and is therefore a normal part of human life (Aldwin, 2007; Bonanno, 2004). In order to get a better understanding of the term *adversity* and its effects, this chapter starts by presenting common scientific classifications of adversities. Subsequently, prominent psychological theories are presented that explain when a situation is experienced as adverse and which effects can occur. Because the effects of adversity crucially depend on psychological coping abilities which start to develop very early in life (Lazarus and Folkman, 1984; Zimmer-Gembeck & Skinner, 2011), an overview is given on how coping normatively develops over the lifespan to show its interdependence with adverse experiences at different life stages.

2.1.1 Definition of adversity

Adversity originates from the Latin term ‘adversitās’ and can be defined as misfortune or difficulty that leads to the experience of distress (Dohrenwend, 1998). Hence, adversity is in close relation to the concept of *distress* as introduced by Hans Selye (1974), who defined distress as the subjective experience of an unpleasant, negative situation in contrast to *eustress* which relates to positive situations such as marriage (Szabo, Tache, & Somogyi, 2012).

A common classification of adversities in research is into (episodic) acute, discrete stressors and chronic, continuous stressors (American Psychological Association, 2018). While acute stressors are characterized by a clear beginning and end such as the loss of important social contacts, chronic (persistent or re-occurring) stressors usually have a gradual onset such as cancer or work-related stressors which maintain over a longer period of time without a clear end (Serido, Almeida, & Wethington, 2004). It applies to all adversities that the negative consequences can last longer than the actual adverse experience depending on its severity and the coping system of the individual, and that these effects can or cannot be consciously perceived (Danese & McEwen, 2012).

Related to this classification are the two most prominent types of adversity in research (Serido et al., 2004): daily hassles and critical negative life events. Daily hassles, such as crowding in public transportation or financial concerns, are minor distressing, re-occurring events and usually experienced as normal (Kohn, 1996; Lazarus, 1999). Critical negative life events, such as job loss or divorce, lead to significant changes and therefore require adaptations in daily life (Holmes & Rahe, 1967). A specific type of critical life events are (potentially) traumatic events. These are extreme forms of adversities, i.e. significant disruptions of life characterized by the (actual, imminent, or indirect) confrontation with death or severe violence that lead to extremer psychophysiological reactions than any other negative experience (Maercker, 2017). Thus, the term *trauma* refers to the situation and the associated subjective

reaction. Traumata are further differentiated into man-made (e.g., sexual abuse) vs. accidental (e.g., natural disaster) events, and single/short-term (e.g., one sexual abuse), multiple/chronic (e.g., re-occurring sexual abuses) and medical (e.g., fatal disease) traumata. Of these, man-made and chronic traumata have been shown to lead to the most negative effects (Maercker, 2017).

Thus, adversities are unpleasant, distressing situations that can be objectively characterized by their frequency, duration and severity. However, the objectively same adversity can be experienced very differently, based on the subjective appraisal of the adversity and the coping resources of the affected individual (Hobfoll, 2001; Lazarus & Folkman, 1984). Accordingly, there is multifinality in the effects of adversity, which can have a lasting impact on personal well-being and how people act in subsequent adversities (Lazarus, 1999).

2.1.2 Psychological perspectives on adversity

The *transactional stress model* (TSM) by Lazarus and Folkman (1984) and the *conservation of resources theory* (COR) by Hobfoll (1989; 2001) explain inter-individual differences in the psychological experience of adversity and its effects. While the TSM focuses on the role of subjective appraisals or evaluations, COR focuses on the potential or actual loss of meaningful resources. Both will be presented and discussed with regard to how they explain the occurrence of negative and positive effects of adversity.

Transactional Stress Model (Lazarus & Folkman, 1984)

The central aspect of the TSM is subjective *appraisal*, which relates to the significance of a situation to an individual's well-being (*primary appraisal*) and what a person can do (*secondary appraisal*).

Primary appraisal can result in the evaluation of a situation as irrelevant, benign-positive, or stressful. An *irrelevant* situation is of no meaning for personal well-being and nothing could be lost or gained, so no actions are initiated. Situations which are evaluated as *benign-positive* are experienced as pleasant and most likely lead to benefits for the individual's well-being. A

stressful situation can be evaluated as harm/loss, threat or challenge. When a stressful encounter has already led to damage or loss, it is evaluated as harm/loss. Traumata are the most damaging situations because they usually lead to the loss of central aspects of life. A threatening situation is characterized by the anticipation of damage and/or loss and negative emotions such as anxiety. In such situations people are called to take actions in order to prevent as much damage as possible. A challenging situation offers possibilities for benefits when successfully coped with and is characterized by positive emotions such as excitement. The latter two evaluations can occur separately and also simultaneously. Furthermore, a situation that has been evaluated as threating at first or has already led to a severe loss can be reappraised as challenging through personal or external coping efforts.

The outcome of a stressful encounter also depends on what a person can do to cope with a situation. How a person evaluates available resources as feasible and effective in light of an adversity to reach a certain outcome is the central aspect of secondary appraisal. Together, these two appraisals crucially influence how stressful a situation is experienced and the emotional as well as behavioral reactions to the situation.

Conservation of Resources Theory (Hobfoll, 1989, 2001)

According to the COR theory, the adverse experience and its outcomes are crucially influenced by how much a situation threatens or leads to the loss of personal or collective meaningful resources. The COR theory states that people have an innate drive to protect and improve their resources as well as to gain new resources. Resources are anything that is per se of value or helps to gain or protect other valued resources such as objects, cognitive resources or significant others. Resources usually function in coherent networks such as coping resources (= *resource caravans*). Therefore, an adversity usually affects several resources at a time.

The COR theory suggests that adversity inevitably leads to a negative impact on resources, which is experienced by the affected individual as stress. This happens either through

the loss of a resource, or due to the depletion of resources as means to protect other resources. Also, if a lost resource cannot be substituted by an equally valuable different resource or if the recovery of invested resources is not possible, this will lead to additional negative effects.

Accordingly, resources have to be investigated and utilized first in order to adapt to an adverse situation. New resources are gained, invested resources are recovered and stress is eliminated if the adaptation is successful. Also, the acquisition of new resources should make future resource gains more likely. If the process of adaptation is not successful and the invested resources do not recover, further resource losses may occur and thereby gradually decrease the resource repertoire of a person. This makes a person more vulnerable, which increases the probability to experience enduring negative well-being outcomes and leads to an increase in current and future stress experiences. This shows that the more resources are lost, the more important become resource gains.

Thus, the COR theory also states potential mechanisms for positive effects. First, especially severe adversities should motivate to repair a damage or loss and to build resources for future resource protection. Furthermore, adversities can help to identify habituated patterns that are not adaptive for the current demands and therefore need adjustment or replacement. Also, resources that are useful to protect other resources can be identified and in turn reinforced. Which resources are valued and invested for managing adversity crucially depends on the individual significance of the resources per se and cultural norms.

Differences and similarities of TSM and COR

A key criticism of Hobfoll on the TSM was the operationalizability of subjective appraisals and therefore focused on a more objective way to assess the severity of adversity by the number of affected resources (Hobfoll, 2001). But when taking a closer look, a subjective evaluation is also inherent in the COR theory by distinguishing between different degrees of value of one's resources. Furthermore, both theories share basic views on when a situation is experienced as

adverse or stressful. The first common decisive factor is significance. While it is the significance of a situation for one's well-being in the TSM, in the COR theory this relates to how much significant resources are affected by a situation. Both agree that a higher significance is associated with a stronger stress experience. The second common important factor is how a person is affected by the adversity. In relation to negative effects of adversity, both theories focus on harm/loss and threat that could lead to losses. COR makes the additional notion that adversities per se always have negative effects at first, because resources are inevitably depleted to deal with an adversity. In contrast, a stressor that is evaluated as a challenge seems not to be related to negative effects according to the TSM.

Furthermore, in light of the fact that adversities are usually investigated from a psychopathological perspective, these classic theories also explicitly notion the possibility of positive effects. While benefits are only expected when a stressful encounter is experienced as a challenge according to the TSM, COR states that actually any adversity has the potential to lead to some form of positive effect. While the TSM does not give descriptions of what can be considered as a positive effect, COR lists the gain of new resources to substitute lost resources, the recognition of dysfunctional resources and the improvement of resources that are functional to protect other resources. It should be born in mind that a new resource can only be beneficial if it is of equal or higher value than the lost one (Hobfoll, 2001). Both theories agree that successful coping is key for experiencing positive effects.

2.1.3 A psychological lifespan perspective on coping with adversity

How people cope with adversities shows pronounced developments and shifts from birth to early adulthood (Skinner & Zimmer-Gembeck, 2007). The biopsychosocial coping system (CS) enables evolutionary crucial adaptive processes which relate to the detection of and response to adversity, and the adaptation of one's coping competencies and performance (White, 1974; Zimmer-Gembeck & Skinner, 2016). The psychological development of the CS proceeds in

close conjunction with pronounced neurophysiological developments during early-life periods (Skinner & Zimmer-Gembeck, 2007). But not only neurophysiological developments shape the functionality and purposes of the CS during early-life, but also the influences of other individuals, most likely caregivers, are central determinants (Zimmer-Gembeck & Skinner, 2011; 2016). In general, coping ideally develops from a mainly emotional bottom-up, short-term focused and heteronomous process to a cognitive top-down, long-term focused and self-determined process (Zimmer-Gembeck & Skinner, 2016). Next, a brief overview on how coping with adversity normatively develops within distinct life periods is given.

Coping during *infancy* and *toddlerhood* is characterized by an 'external coping' process (Zimmer-Gembeck & Skinner, 2016): mainly the caregiver performs the coping for the newborn by providing sensitive emotion regulation and solving the problem. The stress-reaction of the newborn begins with diffuse reflexes and the caregiver has to respond appropriately (DiCorcia & Tronick, 2011). With time the mainly external coping transforms into an interpersonal co-coping, because the child learns which signals it needs to send to elicit certain reactions by the caregiver (Zimmer-Gembeck & Skinner, 2016). This results in implicit action schemata which are activated in stressful situations (Rothbart & Posner, 2006; Skinner & Zimmer-Gembeck, 2007). By the end of the first year the child uses social referencing: it starts to rely on the reactions of the caregiver if a novel situation is distressing and shows the respective reactions (Feinman, 1982).

During *early childhood* more autonomous, i.e. intrapersonal self-regulation is added to the interpersonal co-regulation which is not only guided by emotions and intrinsic motivations, but also gradually by extrinsic motivations (Barrett & Campos, 1991; Kochanska, Coy, & Murray, 2001; Skinner & Zimmer-Gembeck, 2007). The child learns basic social and moral norms by the caregiver and wants to appeal to the caregiver, which leads to the voluntary use of more prosocial coping strategies. The caregiver is still involved in the coping process of the

child by direct participation, especially in overwhelming situations (Zimmer-Gembeck & Skinner, 2011). The child shows an overall higher endurance and patience, as well as better conscious control and executive functioning (Zimmer-Gembeck & Skinner, 2016). Hence, children become able to decide if they want to approach or avoid a situation (Barrett & Campos, 1991).

The main accomplishment of the CS during *middle childhood* is the coordination and reflection of all features of coping on a cognitive level (Skinner & Zimmer-Gembeck, 2011, 2016). The child mentally internalizes its coping strategies and is therefore able to consciously recall the so far implicitly stored coping strategies and weigh their advantages and disadvantages. This leads to a higher context-specificity of coping strategies and novel strategies can develop through mental coping exercises. The direct participation of the caregiver declines during this life period and should change to the provision of feedback and mental help such as giving alternative coping options (Skinner & Zimmer-Gembeck, 2016). A further crucial development should be initiated by the caregiver during this life period: the development of a 'resilient mindset' (Rutter, 2012). This relates to seeing mistakes and failures as opportunities to improve coping (Skinner & Zimmer-Gembeck, 2016).

The final central developments of the psychological coping system during *adolescence* and up into early adulthood are meta-cognition and pro-active coping (Skinner & Zimmer-Gembeck, 2007). Adolescents become better at thinking about their own thinking and can show emotional reactions in response to a former emotion (Compas, Connor-Smith, Saltzman, Thomsen, & Wadsworth, 2001; Skinner & Zimmer-Gembeck, 2016). Further, individuals start to adapt their usual short-term coping responses not only dependent on the current situation or short-term external rewards anymore, but take a long-term perspective on how to better handle future adversities and how their coping could affect other people (Aspinwall & Taylor, 1997; Skinner & Zimmer-Gembeck, 2007). Caregivers further recede into the background, are not

part of the active coping process of the child anymore, and rather function as an optional resource if the child needs help. Hence, adolescents start to flexibly choose their social support (Zimmer-Gembeck & Skinner, 2011).

While the tendency to generally improve resources declines with increasing age, the tendency to maintain resources at a functional level increases with age (Baltes, 1995; Maercker, 2015). Therefore, the coping system in *late adulthood* or *higher age* is aimed at stability and the compensation of resource losses (Baltes & Baltes, 1990).

Summary

Adversity, as it is used in this thesis, is an umbrella term for all kinds of distressing, unpleasant situations which are of significance to the person, threaten or lead to the loss of significant resources, stress or exceed coping resources to some degree, and demand an adaptation (Hobfoll, 2001; Lazarus, 1999; Lazarus & Folkman, 1984). Further, some form and extent of negative effects (e.g., negative affect) is experienced in the first place, but positive effects such as an improved coping ability can result when successful coping occurs.

The development and functioning of the coping system is inevitably connected to adverse experiences over the lifespan and shifts from a focus on improvement to the maintenance of resources (Maercker, 2015; Skinner & Zimmer-Gembeck, 2016). The development of a set of coping strategies to manage adversities starts during the first months of life which are stored in implicit memory. In conjunction with neurophysiological developments humans become increasingly able to consciously reflect on their developed coping strategies and to adapt them to better handle future adverse experiences.

An important step for such beneficial outcomes of adverse experiences might be to evaluate an adversity as challenging right away or through a reappraisal of the initial threatening or damaging situation. Also, a pronounced repertoire of functional resources for coping with

adversity should make beneficial developments more likely and fewer resources should lead to detrimental trajectories (Aldwin & Stokols, 1988; Hobfoll, 2001).

2.2 The traditional, psychopathological perspective on adversity

Adversity is closely related to the concept of *stress* which can lead to negative as well as positive effects (Hobfoll, 2001; Lazarus & Folkman, 1984). Stress is the common term today to describe a negative event (i.e., *stressor*) and the subjective effects of this event on biopsychosocial systems (i.e., the *stress response*; Lazarus, 1999). A stress response is initiated when the resources to cope with a significant situation have been subjectively evaluated as insufficient (Lazarus & Folkman, 1984), which is the case for adversities.

According to the diagnostic criteria of several stress-related psychopathologies (American Psychiatric Association, 1992), the short-term stress response to an adversity is seen as a normal and adaptive reaction to cope with the experience (Boyce & Ellis, 2005; McEwen, 2008; Obradović, 2012; Zimmer-Gembeck & Skinner, 2016). For example, the symptoms of posttraumatic stress disorder have to remain for at least one month (American Psychiatric Association, 1992) and for prolonged grief disorder at least six months (WHO, 2018) in order to be diagnosed with the respective disorder. Therefore, it has to be differentiated between short- and long-term effects of adversity.

On a physiological level, the short-term stress response serves to supply energy in order to fight or flight, a mechanism that is seen as an evolutionary advantageous response to adversity and is not associated with pathological outcomes (Ellis & Del Giudice, 2014; McEwen & Seeman, 1999). Several systems such as the immune, cardiovascular or autonomic system become activated in response to adversity in order to promote adaptation (McEwen, 2008). When an adversity is successfully managed, the physiological systems return to their homeostasis (McEwen, 1998).

However, when an adversity is persistent or repetitive and a person cannot adapt to this situation (e.g., living in a war zone or enduring physical abuse), or when a person cannot successfully cope with a discrete experienced adversity (e.g., job loss, sexual abuse), physiological and/or psychological long-term symptoms are expected to develop which in turn negatively affect a person's life (McEwen, 2008; McLaughlin, et al., 2010). The following section introduces central models which explain the development of negative long-term effects of adversity in general. The subsequent section will give an insight into significant empirical literature on the negative long-term effects of adversity from a lifespan perspective.

2.2.1 Theoretical perspectives on the negative effects of adversity

The first of the following models, the *Vulnerability-Stress Model* (VSM; Ingram & Luxton, 2005; Zuckerman, M., 1999), is the most prominent of individual threshold models in order to explain the occurrence and effects of mental disorders. The subsequent model of *allostasis* and *allostatic load* (McEwen, 1998) focuses on the potential lasting negative physiological effects of especially chronic adversity. The last two complementing approaches, *cumulative risk* (Rutter, 1979; Sameroff, 2000) and *stress sensitization* (Post, 1992), focus on the negative effects of multiple adversities over time.

Vulnerability-Stress Model (Ingram & Luxton, 2005; Zuckerman, M., 1999)

The VSM is an integrative model which uses a multicausal as well as developmental approach to explain the pathogenesis of mental disorders. *Vulnerability* describes the susceptibility or disposition to develop a specific disorder, which can be genetically given and/or acquired. The development of a disorder crucially depends on the fit between the characteristics (e.g., frequency, duration, type, severity) of an adversity (= *stress*) and the 'demands' of a pathology, as well as on one's individual resilience.

A crucial aspect of the VSM is the interdependence between a developed mental disorder and its consequences. A downward spiral can occur when the negative consequences of a

disorder on daily life (e.g., decreasing social support or work performance) and its symptoms (e.g., depressive mood, drug addiction) are reinforcing each other. Also, the VSM states that a developed disorder can negatively influence how subsequent adversities are experienced.

Allostasis and *allostatic load* (McEwen, 1998, 2008)

The concepts of allostasis and allostatic load are in close relation to Selye's *general adaptation syndrome* (1950), one of the first systematic descriptions of the physiological stress response. According to Selye, the response to a threat can consist of three consecutive phases: the first is *alarm* which is the initial stress reaction and characterized by providing physiological energy to take action. The second step is *resistance* where the organism keeps up or intensifies the initial energy for adaptation in order to restore its balance. The final stage, *exhaustion*, which occurs when the stress response has been sustained for too long, is characterized by a decrease of the resistance and finally a collapse of the system.

Allostasis refers to all physiological actions of the body in response to the demands that are placed onto the organism every day in order to maintain internal homeostasis. If and how allostatic systems act, depends on psychological processes such as the appraisal of the situation, individual inherited or obtained vulnerabilities, and the condition of the physiological organism. Importantly, the involved systems themselves are dynamic and can adapt their functioning to future adversity based on prior adverse experiences.

In the case of acute stress responses, allostasis is seen as an adaptive response to adversity by providing all the necessary energy for coping and is therefore associated with healthy outcomes. But when the organism is confronted with demands that cannot be successfully handled over a longer period of time, allostasis places its 'wear and tear' on the body (= *allostatic load*). Allostatic load, i.e., the price the body has to pay for its efforts to adapt, results when allostatic systems cannot shut down and recover, when they function at too high levels, or when they are dysfunctional and therefore lead to dysfunctional activity of other systems. In

turn, allostatic load can lead to enduring maladaptations of allostatic systems (= *biological embedding*; Hertzman, 1999).

Cumulative Risk and *Stress Sensitization*

The *cumulative risk model* (CRM) states a negative linear dose-response relationship between the number of experienced risk factors and well-being (Appleyard, Egeland, Dulmen, & Sroufe, 2005; Rutter, 1979; Sameroff, 2000). Accordingly, the more risks an individual has to face, the higher is the possibility for the onset of pathologies and multi-systemic maladaptation. This indicates that one risk factor alone cannot predict an outcome in its entirety, and therefore multiple risk factors have to be investigated at the same time (Price & Hyde, 2009).

An underlying mechanism of the detrimental effects of cumulative risk might be a *stress sensitization*, which refers to an increasing vulnerability to develop a mental disorder because of an adverse experience as a consequence of former adverse experiences (Espejo et al., 2006; McLaughlin et al., 2010; Rutter, 2012). Originally, stress sensitization was used to describe the fact that with each re-occurring episode of a mood disorder less stress is necessary to trigger the next episode (Post, 1992). An initial, disorder triggering severe adversity is needed, but its association with the further trajectory of the disorder diminishes with each episode (Kendler, Thornton, & Gardener, 2000). One explanation might be maladaptive changes in biological systems associated with the physiological stress response (Heim & Nemeroff, 2001). A further explanation might be that through the repeated activation of dysfunctional cognitive information processing patterns, the activation of such patterns in response to subsequent adversity of lesser severity is eased (Segal, Williams, Teasdale, & Gemar, 1996). Strong empirical support for this effect has been shown for depression (Monroe & Harkness, 2005).

2.2.2 Evidence for the long-term negative effects of adversity from a lifespan perspective

Adversities can have negative effects on diverse biopsychosocial systems of human life (McEwen, 2008; McMahon, Grant, Compas, Thurm, & Ey, 2003). But these systems do not

only develop in response to external events, but also follow a natural development. The brain is seen as the central organ in the processing of and adaptation to adversity (McEwen, 1998, 2008) and is known for its lifelong plasticity (= *neuroplasticity*; Nelson, 1999). Neuroplasticity is especially pronounced in childhood because of the brain's intensive biological development during that time. Therefore, childhood is seen as a critical and sensitive period for external influences and especially vulnerable for the influence of adversities (Danese & McEwen, 2012; Fox & Rutter, 2010; Friedman, Montez, Sheehan, Guenewald, & Seeman, 2015; Shonkoff et al., 2012). Accordingly, research has placed a special emphasize on studying the negative long-term effects of ELA. Hence, the following empirical overview on the negative effects of adversity is split into childhood adversities and adversities in later life.

Childhood adversities

Childhood adversities are associated with man-made adversities such as emotional and physical abuse, sexual abuse, or parental health (such as mental disorders) and behavioral (such as substance abuse, inter-parental violence) problems which usually co-occur (Ehlert, 2013). Several large scale studies were able to show the positive association between ELA and the prevalence of mental disorders in later life. A cross-sectional study with over 50.000 adults from 21 countries found that ELA account for 29.8% of 20 common mental disorders in adulthood (Kessler et al., 2010). Another cross-sectional study with about 35.000 adult US citizens found that ELA increase the vulnerability to the development of anxiety and mood disorders in response to adverse experience in adulthood (McLaughlin et al., 2010), a verification of the stress sensitization hypothesis. Furthermore, a longitudinal study with about 9.000 adults in Britain found ELA to be strong predictors of psychopathology throughout life, while the association slightly declines with age (Clark, Caldwell, Power, & Stansfeld, 2010). The study also found evidence for the CRM by showing that the odds of developing a disorder increased with an increasing number of ELA (Clark et al., 2010).

Childhood adversities have also been related to health and risk behavior in later life. A study with over 17.000 adult US citizens was able to show that an increasing number of ELA is associated with a higher risk for sleep disturbances, obesity, substance abuse, and sexual risk behavior (Anda et al., 2006). Furthermore, this study showed a higher prevalence for memory impairments and higher level of perceived stress in adulthood for higher levels of ACE. Childhood adversities have further been associated with deficits in cognitive (cognitive performance, executive functioning, recall) and emotional domains (empathy, emotion regulation) (Pechtel & Pizzagalli, 2010).

Childhood adversities have also been found to negatively influence allostatic systems already in childhood, which can persist up into adulthood, giving evidence for potential enduring (mal-) adaptations of these systems (Shonkoff et al, 2012). For example, children and adults with ELA can show an impaired functioning of the prefrontal cortex, which is related to impaired executive functioning and concentration, as well as impulsiveness and hyperactivity (Danese & McEwen, 2012). Further effects can be elevated as well as blunted basal cortisol levels and elevated inflammatory levels which can lead to a dysfunctional HPA axis activity (Danese & McEwen, 2012; Ehlert, 2013). This is associated with a heightened stress perception and responsiveness, impaired immune functioning and a higher vulnerability for disease such as cardiovascular diseases and cancer (Ehlert, 2013; Johnson, Riley, Granger, & Riis, 2013). Furthermore, a decreased volume of the hippocampus of adults with ELA has been found which can lead to a higher vulnerability to develop a depression or posttraumatic stress disorder in adulthood (Danese & McEwen, 2012). Strikingly, such (mal-) adaptations can be passed on to subsequent generations (Ehlert, 2013) and lead to an increased biological aging (Danese & McEwen, 2012).

Adversities in later life

Even though childhood is seen as a sensitive period for the negative influence of adversity, also adversities experienced in later life periods are known for their psychopathological and pathophysiological effects. Studies on the potential negative effects of daily hassles have shown that they can be associated with an unhealthy eating behavior (O'Connor, Jones, Conner, McMillan, & Ferguson, 2008), the wish to die (Lapierre et al., 2012), marital dissatisfaction (Harper, Schaalje, & Sandberg, 2010), depression (McIntosh, Gillanders, & Rodgers, 2009), or health problems such as headache, illness, cardiovascular disease, and mood disturbances (DeLongis, Folkman, & Lazarus, 1988; Everson-Rose & Lewis, 2005). Also, severe adversities in adulthood have been shown to trigger the development of mental disorders (Maercker, 2017; McLaughlin et al., 2010; O'Connor, Nickerson, Aderka, & Bryant, 2015) and physiological diseases (McEwen, 2008), suicidal behavior (Devries et al., 2011), and substance abuse (Wolff, Rospenda, & Colaneri, 2017). Also, higher levels of chronic adversities can lead to higher levels of morbidity and mortality (Miller, Chen, & Cole, 2009), and a faster decrease in cognitive and physical functioning due to an enduring allostatic load (Juster, McEwen, & Lupien, 2010; Seeman, McEwen, Rowe, & Singer, 2001).

Summary

The presented literature implies that the initial, short-term stress response has an adaptive function to protect well-being. When this short-term stress response persists or is often repeated, enduring changes of the involved psychophysiological systems most certainly result. Maladaptive, pathological long-term outcomes will most likely occur in cases where the stress response does not lead to successful coping, especially in the context of severe, chronic adversity that affords the organism to stay in a constant attempt of coping.

Studies have shown the lasting detrimental biopsychosocial effects of ELA and adverse experiences in adulthood. Adversities usually co-occur and a higher number of experienced

adversity has been related with higher odds for maladaptation and pathologies. The effects of adversities can be especially pronounced and long-lasting in childhood and passed on to subsequent generations.

This suggests that experiencing no adversity is optimal for human development and well-being. But as the presented studies have shown, adversities are inevitable throughout life and not every person shows negative outcomes. In fact, the ability of humans to successfully cope with adversity and to continue normal development seems to be more common than negative outcomes (Bonanno, Brewin, Kaniasty, & La Greca, 2010; Masten, 2001).

According to the mentioned models (see 2.2.1), this depends on the more autonomic allostatic systems (biological resources) as well as on more or less autonomic (e.g., cognitive thinking patterns, personality factors) and consciously usable (e.g., coping strategies, social network) psychosocial resources, which are collectively referred to as *resilience*.

2.3 Resilience

While the first studies on resilience defined it as a rather trait-like psychological construct to differentiate people who can withstand adversity from people who are negatively affected by adversity (Block & Block, 1980), current perspectives on resilience define it as a dynamic, multi-systemic (biopsychosocial and ecological) construct (Masten, 2014; Rutter, 2012; Ungar, 2011). Overall, resilience is the capacity of dynamic, interacting systems of an individual to adapt to adversity of any kind and severity in order to successfully withstand and cope with it, recover fast after an adverse experience, maintain or return to homeostasis, and to go on with positive, normative development despite adversity (Aldwin, 2007; Bonanno, 2004; DiCorcia & Tronick, 2011; Juster et al., 2010; Masten, 2014; Rutter, 2012, 2013; Ungar, 2011). These systems can be categorized into ‘core’ resources such as allostatic systems, health behavior, gender, age; ‘internal’ psycho-social resources such as close relationships (e.g., family, friends), skills/abilities/knowledge (e.g., coping strategies, self-efficacy, hardiness); and ‘external’

socio-ecological resources such as social services, socio-economic status, or religion (Liu, Reed, & Girard; 2017; Ungar, 2011). Also, resilience resources can be functional across different situations and also context-specific (Rutter, 2012; Ungar, 2008). Therefore, resilience encompasses all resources that are necessary for a successful short-term stress response and recovery of the stressed systems.

Furthermore, despite the more autonomic functioning allostatic systems and given characteristics such as age or gender, resilience is not only about the availability of resources, but also crucially depends on the individual accessibility and feasibility of resources (Aldwin, 2007; Ungar, 2011). Additionally, since the individual resilience is also influenced by socio-ecological resources, which become more important with an increasing severity of adversities (Ungar, 2016), also cultural values influence the availability and accessibility of potential necessary resources for coping (Ungar, 2011).

This presentation of resilience via functional and adaptive resources mirrors the traditional approach to resilience in research: to identify resources that help people to withstand, adapt to and overcome adversity. Based on the identified resources, interventions are implemented that help people to attain these resources such as an increase in optimism (Seligman, 2011), or a change in negative cognitive thinking patterns (Reivich & Shatté, 2002). Such psychological interventions can also affect allostatic systems (Hammerfald et al., 2006).

However, all mentioned theories and models so far show another source for the development of resilience: the adverse experience per se (Hobfoll, 2001; Ingram & Luxton, 2005; Lazarus & Folkman, 1984; McEwen, 1998; Rutter, 2012; Zimmer-Gembeck & Skinner, 2016). Probably because negative outcomes are subjectively more salient compared to objectively equivalent positive outcomes (Kahneman, & Tversky, 1979), people are commonly preoccupied with the negative outcomes of adversity, and research and praxis have predominantly focused on them (Seligman, 2012; Tedeschi & Calhoun, 2004). While it is

without dispute that psychopathological research is essential, a salutogenic perspective on adversity could help to better understand the dynamics between adversity and well-being as well as show additional ways to foster resilience.

2.4 A salutogenic perspective on adversity

All systems that are involved in the immediate response to adversity aim at adaptation to overcome it as soon as possible. Resilience is the crucial factor for the successfulness of this short-term adaptation. The pathological literature suggests that the short-term adaptation itself, and therefore the involved systems, is adaptive and can change in response to adversity, which influences the response to subsequent adversities (Post, 1992; Rutter, 1979; Sameroff, 2000). In contrast to a pathological perspective that is concerned with a maladaptation of these systems, a salutogenic perspective focuses on how these systems could positively progress and result in an increased resilience, an improved ability to protect well-being, and a healthy development (Antonovsky, 1987, 1996).

The fundamental question that has to be answered first is what can be generally considered as 'positive effects' of adverse experiences. Second, the two major approaches to the salutogenic effects of adversity in research are presented, followed by central antecedents of such effects. Finally, the importance of this thesis' topic for human development from a lifespan perspective is given.

2.4.1 What can be considered as positive effects of adversity?

It is generally assumed that a healthy, successful physiological long-term adaptation is expressed by a habituation, i.e., a gradual decrease of the short-term physiological stress response to an adversity by repeated exposure (McEwen, 1998). Concerning psychosocial resources, gaining new resources, improving available functional resources, or abandoning resources that are dysfunctional in a given context can be considered as positive (Hobfoll,

2001). Therefore, two perspectives need to be considered when stating if a positive (or negative) development has happened: *situativity* and *norms*.

Situativity and *conditional adaptation*

According to situativity theory, individual knowledge and skills, thinking, emotion and learning derive their meaning only in relation to a specific context (Durning & Artino, 2011). It proposes an interdependency between all the systems that are involved in a situation and that components change depending on their situative functionality. Accordingly, the characteristics of the stress response should be dependent on the usual environment where it takes place and adapt according to novel situative affordances (Norman, 1988).

In the stress literature, this concept has been introduced as *conditional adaptation* (Boyce & Ellis, 2005) or *adaptive calibration* (Ellis & Del Giudice, 2014). According to the *adaptive calibration model* (Ellis & Del Giudice, 2014), each allostatic load should be viewed in terms of a resource-allocation that depends on the demands of a current situation and influences future resource-allocations. Therefore, what would traditionally be viewed as a maladaptation, such as lastingly increased cortisol and inflammation levels or paranoid behavior, is seen as adaptive when living in a highly unpredictable and threatening environment (Danese & McEwen, 2012; Richardson, Castellano, Stone, & Sanning, 2016). Such strategies are termed *fast life history strategies*, which are adaptive in the short-term in stressful environments, but lead to reduced health and faster aging in the long-term (Ellis & Del Giudice, 2014). In contrast, *slow life history strategies* are related to resource allocations that support well-being and longevity (Ellis & Del Giudice, 2014).

These perspectives imply that any change of a component of the short-term stress response is per se adaptive for short-term survival in a specific context (Obradović, 2012). It further implies that a context-specific adaptation can be dysfunctional in another context and

that the long-term outcomes of the adaptation of the short-term stress response can be positive or negative.

Norms

Norms express what is seen as normal or abnormal from a specific perspective such as subjective, functional, statistical, ideal or cultural norms. Situativity can be seen as a form of subjective functional norm (Sherif, 1936), because the individual context determines what can be seen as positive or negative. But humans function in a social world, where also cultural norms guide the evaluation of what is positive and negative. Hence, if a person wants to be part of a collective then the respective norms and values of that group should be met (Hobfoll, 2001; Ungar, 2011). Therefore, the proximal culture of an individual not only influences which collective resources are available and accessible for coping, but it can also influence how an individual develops in response to adversity.

Given these different views (situativity vs. cultural norms) of what can be considered positive effects of adversity, this thesis is concerned with developments of psychological slow life history strategies that would be individually and socially valued, and thus be genuine salutogenic effects of events, where such developments would not be expected in the first place (Carver, 1998). Therefore, the remainder of the theoretical background is concerned with such positive psychological effects of adversity.

2.4.2 The psychological research landscape of salutogenic effects of adversity

Several concepts have been introduced into the scientific literature to describe positive psychological effects of adversity, which can be categorized by the severity of adversity they relate to. The first group encompasses terms that generally relate to positive effects of adversity: *thriving* (Carver, 1998; O'Leary & Ickovics, 1995) and *stress-related growth* (Aldwin, 2007). The second group relates to an 'optimal' level of adversity for human well-being and

development: *inoculation* (Meichenbaum, 2017), *immunization* (Garmezy, 1986), *steeling* (Rutter, 2012; Liu, 2015), and *toughness* (Seery, 2011). The third group is concerned with the positive effects of overwhelming life events: *posttraumatic growth* (Tedeschi & Calhoun, 2004), *adversarial growth* (Linley & Joseph, 2004), and *benefit finding* (Affleck & Tennen, 1996). In the following, the last two groups will be presented in more detail. The positive effects of 'optimal adversity' will be collectively referred to as 'steeling' and the positive effects of overwhelming adversity will be referred to as 'growth' from here on.

2.4.3 Steeling: Salutogenic effects of 'optimal' adversity

Steeling is associated with a specific ('optimal' or 'moderate') level of adversity that leads to 'optimal' improvement and outcomes (DiCorcia & Tronick, 2011; Liu, 2015). 'Optimal' adversity is predictable, controllable and manageable through already available resources, which are characteristics of a challenge (Dienstbier, 1992; Fergus & Zimmerman, 2005; Liu, 2015; Meichenbaum, 2017; Rutter, 1987, 2013). According to the TSM (Lazarus & Folkman, 1984), challenges inherit the opportunity for improvement, but in contrast to the TSM, challenges in the context of steeling are more accompanied by negative than positive emotions (Liu, 2015). Furthermore, even though adversity is rather associated with avoidance-motivation (Blascovich, 2013), 'optimal' adversity should elicit an approach-motivation because the positive superordinate aim is to protect significant threatened resources and the affected person has sufficient coping resources (Hobfoll, 2001; Lazarus & Folkman, 1984). Therefore, 'optimal' adversity should be a combination of a threat and challenge.

A crucial distinction from lower and higher levels of adversity is that the demands of an 'optimal' adversity are within, but at the outer limits of one's coping capacities and hence need significant efforts for coping, but still give sufficient flexibility to take actions and make successful coping possible (Carver, 1998; Lazarus & Folkman, 1985; Rutter, 1987, 2012). Accordingly, 'optimal' adversity provides a context to apply and practice coping skills and to

optimally improve resources (Bonanno & Diminich, 2013; Fergus & Zimmerman, 2005; Lazarus & Folkman, 1984; Liu, 2015; Rutter, 1987; Seery, 2011). Therefore, because coping operates within one's abilities, 'optimal' adversity is rather related to an improvement of available resources than the acquisition of new resources, which should happen when the demands of a situation exceed the available resources (Bonanno, Westphal, & Mancini, 2011; Vygotsky, 1978). But steeling should not only positively influence the applied context-specific strategies, but should also lead to an overall improvement of one's psychological adaptability (Rutter, 2006, 2012). Hence, when being confronted with 'optimal' adversity, broader endogenous resources such as self-esteem, self-efficacy, self-confidence or mastery should also improve which positively influence the experience of other future adversities (Dienstbier, 1989; Liu, 2015; Rutter, 2012).

A further distinction between 'optimal' and overwhelming adversity is the type of loss that can occur. Overwhelming adversity is associated with some form of inevitable negative loss such as fundamental assumptions about the world or external losses such as significant belongings or persons (Janoff-Bulman, 2004). In contrast, 'optimal' adversity should rather be related to some form of positive voluntary loss of resources (Hobfoll, 2001) which have been proven as dysfunctional in a given context.

In sum, steeling leads to a heightened resilience, lowered vulnerability and higher well-being because of the successful coping with distal adversities which helps to protect from the negative effects of proximal adversity (Rutter, 2012).

2.4.4 Growth: Salutogenic effects of overwhelming adversity

Growth relates to a specific set of positive outcomes in response to traumatic, overwhelming adversity (Tedeschi & Calhoun, 2004). First, new schemas can be build which incorporate not only the trauma, but also a new definition of the world and one's role in it (Janoff-Bulman, 2004). Because despite the fact that people know that bad things can happen,

they do not believe that such things could happen to them personally (Janoff-Bulman, 2004). Therefore, new schemas develop in response to overwhelming adversities that incorporate a somewhat more negative, but also more realistic view of the world, which increases one's general adaptability and resilience to future adversities (Janoff-Bulman, 2004; Zoellner & Maercker, 2006). This is usually accompanied by an improved appreciation of life in general and parts of everyday life, as well as one's own existence and social relationships (Tedeschi & Calhoun, 2004). Growth further encompasses the potential re-evaluation and re-prioritization of what is of value in life, which often leads to see new possibilities or to choose a different life trajectory (Tedeschi & Calhoun, 2004). Additionally, affected individuals can also improve in their sense of being a strong person and spirituality (Tedeschi & Calhoun, 2004). Therefore, resources develop which should improve resilience on a fundamental level and should be useful for the coping with any kind of adversity. But it has also been shown that new adversity-specific resources should develop in the aftermath of overwhelming adversity so that affected individuals or communities have better knowledge and skills to deal with the same adversity a second time (Bonanno et al., 2011; Knight, Gatz, Heller, & Bengtson, 2000). While all these salutogenic effects are expected to likely occur in response to overwhelming adversity, especially the changed assumptions, beliefs, values and priorities, they can also gradually occur in response to lower-level adversities (Tedeschi & Calhoun, 2004; Janoff-Bulman, 2004).

A crucial issue in the growth literature is if and how growth positively affects well-being (Zoellner & Maercker, 2006) and therefore, if growth belongs to the genuine salutogenic effects of adversity. It is almost undeniable that overwhelming adversity is tied to some kind of negative loss. But as the Janus-Face model of posttraumatic growth points out and as is inherent in the meaning of 'successful coping', genuine (as opposed to illusionary) growth should positively influence well-being (Zoellner & Maercker, 2006). As of such, these forms of genuine salutogenic effects belong to the highest potential of human existence (Frankl, 1959).

2.4.5 Antecedents of genuine salutogenic effects of adversity

As the former two chapters have shown, the successful coping with an adversity, if mainly in-situ in the case of 'optimal' adversity or in the aftermath of an overwhelming adversity, is the crucial key for genuine salutogenic effects of adversity. The necessary resources to cope should be in relation to the severity of an adversity: with increasing severity internal resources should become less sufficient and socio-ecological resources should become more important (Ungar, 2016). Furthermore, the more significant resources are affected by an adversity, the higher should be the chance for positive outcomes, because a person should be motivated to prevent a second harm or loss of the same magnitude (Hobfoll, 2001). A further crucial precondition, which is inherent in the characteristics of increasingly severe adversities, is an 'insufficient' resilience, i.e., room for development and vulnerability to some extent, because highly resilient people have no need for improvement and are not negatively affected by adversity (Bonanno, 2005). Together, this indicates that the motivation to become more resilient is caused by a situation or affected resource of high significance and the person experiences personal limits and vulnerability (Banas & Rains, 2010; Hobfoll, 2001; Lazarus & Folkman, 1984; Tedeschi & Calhoun, 2004).

A crucial process in the case of growth is cognitive processing (Tedeschi & Calhoun, 2004). Cognitive processing relates to a variety of deliberate positive ruminative strategies such as re-appraisal, meaning making, or acceptance, which must follow the initial intrusive cognitions that are a normal reaction to an overwhelming adversity for growth to occur (Tedeschi & Calhoun, 2004; Zoellner & Maercker, 2006).

Given these underlying mechanisms, there is still the question of what is needed to actively engage in the necessary processes that lead to positive effects. Several personality factors and resources have been proposed: optimism, neuroticism, openness, emotion regulation, hardiness, self-efficacy, locus of control, sense of coherence, self-control, active

coping, cognitive control, social support and socio-economic status (Aldwin, 2007; O'Leary & Ickovics, 1995; Tedeschi & Calhoun, 2004; Zoellner & Maercker, 2006). Furthermore, people need to be aware of their resources as well as able to access and effectively use them (Aldwin, 2007; O'Leary & Ickovics, 1995; Ungar, 2011). Also, self-confidence should play a crucial role, but can have contrasting effects when a person is confronted with a significant stressor: while a high self-confidence should lead to a high coping engagement, a low self-confidence should lead to giving up (Carver, 1998; Rutter, 1987). Further, especially in the case of overwhelming adversity it is important to manage distressing emotions first and to recognize the positive and negative effects (Tedeschi & Calhoun, 2004). In the case of steeling, a self-reflective 'steeling' mind-set, i.e. the conscious perception of functional and dysfunctional coping strategies as well as the cognitive schema that one can benefit from adverse experiences, should be important (Rutter, 2012).

2.4.6 A developmental perspective: Salutogenic effects of adversity and successful aging

Inherent in the topic of this thesis is a developmental perspective, because each experience of an adversity should at least influence the subsequent same experience and dependent on the severity of an adversity also other adverse experiences (Bonanno et al., 2011; Rutter, 2012; Tedeschi & Moore, 2016). Thus, ongoing context-specific and global salutogenic developments can be initiated by adversity that lead to an ongoing increase in resilience and associated positive well-being outcomes.

Viewed objectively, each adverse encounter can lead to a gradual to sudden increase in resilience when successfully coped with. While an advantage of multiple exposures to overwhelming adversity for the development of resilience is not mentioned in the literature, steeling is associated with relatively brief and re-occurring adverse experiences, and the time between several (re-occurring) adversities should leave enough room for sufficient recovery (Carver, 1998; Dienstbier, 1989; Liu, 2015; Rutter, 2012). This time is necessary for the

restoration of depleted resources and for the consolidation of new resources (Carver, 1998; Hobfoll, 2001; McEwen, 1998). Further, because the effects of 'optimal' adversity are usually compared to optimal physical exercise, also progressive training through 'optimal' adversity is hypothesized to foster the improvement of resilience (DiCorcia & Tronick, 2011). Hence, steeling is based upon the assumption that some level of adversity is probably necessary for optimal human development, functioning and well-being (Aldwin, 2007).

From a lifespan perspective, the successful coping with adversity should be enabled as early in life as possible to launch an ongoing preventative process via ongoing resilience-improvement throughout life (Aldwin, 2007; Liu, 2015). This is of further importance because early-life has been found to be sensitive for the influence of external events which can have lasting effects up into higher age (see 2.2). Because of this childhood sensitivity and potential lifelong imprints, research on resilience-enhancing and well-being protecting mechanisms focuses mainly on early-life (Masten, 2014). Furthermore, the outcomes of this research are usually related to pathological and normative development (Bonanno, 2004; Masten, 2001).

However, if this preventative process is already enabled in early-life and maintained throughout life, this might lead to a third potential trajectory: optimal or successful aging (SA; Maercker, 2015; Rowe & Kahn, 1987, 2015). Successful aging commonly relates to well-being and development in later life, but is also seen from a lifespan perspective so that earlier experiences and developments influence its occurrence (Rowe & Kahn, 2015). While normative aging is related to ordinary decreases in functionality and the achievement of the average lifespan, and pathological aging is associated with accelerated psychophysiological decreases and associated pathological effects, SA is a "better than" normative aging (Maercker, 2015; Rowe & Kahn, 2015). The three central components of successful aging are "low risk of disease and disease-related disability; maintenance of high mental and physical function; and continued engagement with life, which includes relations with others and productive activity, either paid

or volunteered (Rowe & Kahn, 2015, p. 593).” Central for SA is adaptability, so that people in later life are able to successfully adapt to circumstances that could interfere with their central life goals and to maintain their central resources at a functional level (Baltes & Baltes, 1990; WHO, 2015). As has been outlined in this chapter, the process that leads to this adaptability could already start in response to ELA, but also adversities in later life could help to positively influence it. Therefore, in light of the pronounced global increase of life-expectancy and the expected increasing number of people in higher ages (WHO, 2015), the topic of this thesis could be a crucial underlying mechanism for SA.

Summary

What can be considered as positive psychological effects of adversity depends on the individual current situation, cultural values, and the long-term outcomes of the short-term stress response and associated adaptations. This thesis focuses on genuine salutogenic effects of adversity, i.e. effects that are individually and culturally valued and that foster well-being and longevity.

Many concepts have been introduced into the literature to describe such effects of adversity, which relate to two kinds of adversities: ‘optimal’ and overwhelming. While a person is able to cope within the first context and therefore the utilized resources should develop and no long-term negative effects are expected, the second context most likely leads to an existential re-evaluation or transformation and is most likely accompanied by some irreversible negative loss.

Positive effects of adversity should always be context-specific, but with increasing severity also broader resources can develop that positively affect the experience of other adverse situations. The main positive effects of adversity are a heightened psychological resilience and lowered vulnerability which can be expressed in manifold ways: desensitization (i.e., reduced sensitivity to adversity), faster recovery after an adversity, higher level of functioning, gains in skills, knowledge, self-confidence, or a loss of dysfunctional resources

(Carver, 1998; Hobfoll, 2001; Rutter, 2012). Further, more realistic and resistant higher-order fundamental assumptions about the world as well as a higher appreciation of and meaning in life can result (Tedeschi & Calhoun, 2004; Janoff-Bulman, 2004). These resources can develop gradually or also more suddenly in response to overwhelming adversity.

The most significant predictor for genuine salutogenic effects is successful coping, which depends on personality factors, cognitive-emotional as well as socio-ecological resources. While mainly the success of the coping process determines if negative or positive outcomes results, the level of adversity influences the likelihood of possible resources that can improve. Further, the significance of an adversity and the experienced vulnerability should be the driving forces that lead to active engagement with the adversity and its negative effects.

Taken together, experiencing no adversity at all already early in life seems to lead to the worst perspectives for lifelong development and well-being, but only if successful coping occurs (Aldwin, 2007; Liu, 2015; Zoellner & Maercker, 2006). In light of the global occurrence of childhood adversities, the normality of stress in everyday life, normative major adverse life transitions, and unexpected overwhelming adversities that can happen anytime, this research has high preventative as well as therapeutic meaning (Zoellner & Maercker, 2006).

3. SIGNIFICANCE OF THE PRESENT THESIS

This cumulative thesis consists of three scientific studies, each using a different methodological approach. In the following, the rationales for each study will be separately presented.

3.1 Rationale Study 1: A systematic review of the salutogenic effects of 'optimal' adversity

The research on growth usually assesses subjectively perceived positive effects of the most severe adverse experience in life or of a predetermined adversity (Zoellner & Maercker, 2006). Hence, participants have a relatively clear picture about the adversity at question.

However, this is not the case in the domain of steeling where 'optimal' or 'moderate' adversity is researched and therefore there exists no standardized definition of such adversity and explicit examples cannot be given (Liu, 2015; Obradović, 2012). What's more, while growth is concerned with single experiences, 'moderate' refers to the subjective experience of single as well as the joint effects of an 'optimal' amount of adversities (see 2.4.6). Furthermore, while 'moderate' in relation to steeling relates to an overall perspective on the level of experienced adversity (Liu, 2015), i.e. a 'moderate adversity' or 'moderate amount of adversity', a curvilinear relationship is also assumed between the severity of a traumatic experience and positive outcomes in growth (Tedeschi & Calhoun, 2004), i.e. a 'moderate severe trauma'. So an objectively traumatic adversity might have to be subjectively experienced as moderate for the highest chance of growth. Therefore, the term 'moderate' seems to have several different theoretical meanings and a systematic review of the empirical literature is needed to verify them. Also, empirical research mainly uses linear models that could obscure the effects of specific levels of adversity, which might have led to the common psychopathological perspective on adversity (Masten & Cicchetti, 2016; Meyerson, Grant, Carter, & Kilmer, 2011). In addition, while theoretical explanations of why moderate adversity

should be optimal for human well-being and development are relatively comprehensible (see 2.4.3), and metaphorical comparisons can be made to optimal physical exercise or the functioning of the immune system whose functionality relies on the confrontation with manageable pathogens, a systematic evaluation of the empirical literature that gives an insight into the salutogenic effects of 'optimal' adversity is lacking to show its genuineness.

3.2 Rationale Study 2: A quantitative, longitudinal study on the function of 'optimal' adversity in later life

The salutogenic effects of 'optimal' adversity for human well-being rely on the assumption that the successful coping with an 'optimal' level of adversity leads to an improvement of broad endogenous resilience resources (Dienstbier, 1989; Rutter, 2012; see 2.4.3). Such developments should be assessed via longitudinal studies with the repeated assessment of the same resources over time and the prediction of their change by the experienced adversity in that time (Liu, 2015). However, the few longitudinal studies that have been conducted in relation to 'optimal' adversity have focused on the outcomes of this relationship rather than investigating changes in resources (see 8.1.1). For example, studies have shown the protective effect of a moderate amount of distal adversities on the negative effect of proximal adversity (Hagan, Roubinov, Marreiro, & Luecken, 2014; Ruch, Chandler, & Harter, 1980), and the fastest decrease in psychological problems in relation to a moderate amount of combat experiences during war (Schnurr, Rosenberg, & Friedman 1993). While these studies give first longitudinal evidence for steeling, they do not investigate the underlying mechanisms of these effects.

Furthermore, as the research on resilience-enhancing mechanisms is traditionally conducted in early life (Masten, 2014), little is known about potentially underlying mechanisms, such as for instance steeling, in later life. But as the psychopathological research on the effects of adversities in later life has shown, development and well-being can be influenced by adverse experiences in later life (see 2.2.2). Accordingly, experiencing an

‘optimal’ level of adversity could also lead to salutogenic effects in later life. However, since the aim of later life is not to improve resources, but to maintain them at a functional level for a high well-being (Baltes & Baltes, 1990; Maercker, 2015; WHO, 2015), ‘optimal’ adversity could have a different function in later life than would be expected by the current definition of steeling (see 2.4.3). As of that, it was the aim of this study to investigate the potential role of ‘optimal’ adversity for development and well-being in later life.

3.3 Rationale Study 3: A qualitative study on successfully aged *Verdingkinder*

Pathological studies have shown that severe ELA very likely lead to lasting negative impacts on the human aging process and well-being up into higher age, because childhood is supposed to be a sensitive window for the influence of external events (see 2.2.2). Nevertheless, from a salutogenic perspective, there is also the possibility of lasting positive effects of severe adversity under the right circumstances in the sense of growth (see 2.4.4), which should foster lifelong successful aging. But according to the theoretical assumptions of growth and as has been shown in the empirical literature, children should rather unlikely experience growth (Tedeschi & Calhoun, 2004; Meyerson et al., 2011). Children might have not developed the necessary fundamental assumptions that are supposed to be shattered by severe adversity and the respective cognitive resources for growth to occur. Therefore, individuals in higher age need to be studied who have a high well-being and had to experience severe ELA in order to investigate the hypothesis if and how they have aged successfully not despite, but also because of their ELA. This could give significant insights into the resources that might be needed during and after severe ELA, and the associated salutogenic developments for successful aging to occur. To get an insight into these gaps in the literature, this study was conducted to interview a group of successfully aged elderly people who had to experience rather severe ELA. For the purpose of this study, a specific subpopulation of Switzerland, the *Verdingkinder*, i.e. formerly indentured child laborers, was interviewed.

4. THE PRESENT THESIS

Adversity has long been viewed from a psychopathological perspective. But adversity can also be a source for salutogenic developments and help to live a more fulfilled and highly functioning life up into higher age. It is therefore the aim of this thesis to give insights into how adversities that are experienced in different periods of life can contribute to a healthy development, resilience and well-being in later life. Furthermore, this thesis wants to give a clearer understanding of 'optimal' adversity.

This chapter presents an overview of the empirical project and the three resulted papers that constitute this cumulative thesis. The papers can be read in their entirety in the appendix.

4.1 Project Overview

This thesis is based on the mixed-methods project '*Healthy Aging against the Odds – Mechanisms behind the Steeling Effect* (HEAST)' which was conducted at the University of Zurich, Switzerland. It consisted of one theoretical study and two empirical sub-studies: a quantitative longitudinal survey study with two assessments one year apart (Sub-Study I) and a qualitative interview study with successfully aged older Swiss former indentured child laborers, i.e. *Verdingkinder* (Sub-Study II). The interviews and first quantitative assessment took place in summer 2016 (t_1) and the second quantitative assessment took place in summer 2017 (t_2).

The project was approved by the Swiss Ethics Committee of the Canton of Zurich (ID 2015-00135) and the Ethics Committee of the Faculty of Philosophy in the University of Zurich, Switzerland. Financial support was received by the Jacobs Foundation.

4.2 Summary Study 1: A systematic review of the salutogenic effects of 'optimal' adversity

Aim: The salutogenic perspective on adversity suggests that adversity may inherit opportunities for resilience- and well-being enhancing effects. According to the *steeling effect*, there might exist an 'optimal' level of adversity which facilitates more adaptive functioning (resilience) than lower and higher levels. This relationship may be adequately assessed using curvilinear models, yet the majority of previous studies have examined linear associations. It is therefore the aim of this review to determine whether optimal adversity is associated with more adaptive functioning and positive outcomes compared to lower and higher levels of adversity.

Methods: A systematic review was conducted according to PRISMA using the online databases PsychINFO, Pubmed, and Scopus. Also, the references of selected articles were screened for eligible studies and forward citation searching was conducted on the final articles.

Results: Of the initially found 6841 articles, 27 studies complied with the inclusion criteria. The studies looked at the effects of single as well as cumulative adversities. The majority of studies found more significant curvilinear than linear relationships. Positive effects of 'optimal' adversity were indicated by increases in positive indicators of well-being (including posttraumatic growth) and resilience to adversity, decreases in symptoms or indicators of ill-health (psychological and physiological) and risk-factors of well-being.

Discussion: Since almost every study used an individual operationalization of adversity, no clear statement can be made about the 'optimal' level of adversity. Nevertheless, studies showed that some or moderate adversity appears to be better for well-being and adaptive functioning compared to higher and lower levels of adversity. This research points to a largely unrecognized and potentially at high-risk population of individuals with no or too few experiences of adversity. Future research should employ longitudinal studies to examine perceived and actual changes in resilience and well-being over time in response to adversity.

4.3 Summary Study 2: A quantitative, longitudinal study on the function of 'optimal' adversity in later life

Aim: The *steeling effect* suggests that an 'optimal' level of adversity enhances endogenous psychological resilience resources that underlie the potential genuine salutogenic effects of 'optimal' adversity on well-being. However, there is lack of research in diverse age groups and longitudinal investigations of steeling. Research on successful aging suggests that 'optimal' adversity might support a maintenance rather than an increase of resources in later life. It was therefore the aim of this study to examine the function of 'optimal' adversity in later life.

Methods: The sample consisted of N = 187 participants (M_{age} = 67.32 years, SD = 8.54). A one-year longitudinal survey study was conducted. Socio-demographics, adversity experienced over the last year, resilience resources, and satisfaction with life (SWL) were assessed. Latent profile analysis was used to identify profiles of change in resilience resources which were analyzed for differences in the other study variables.

Results: A three profile solution showed the best fit to the data. One profile showed an overall decrease in resources ('Decrease'), the second relative stability of resources ('Maintenance'), and the third an overall increase of resources ('Increase'). The profiles differed significantly in adversity: 'Decrease' was characterized by low, 'Maintenance' by moderate, and 'Increase' by high adversity, which contrasts the 'classic' steeling-effect. A significant age effect was found, with more older participants belonging to the 'Maintenance' and more younger participants to the 'Increase' profile. Significant differences were found in the change of SWL between 'Decrease' (decreased SWL) and 'Increase' (increased SWL).

Discussion: This study shows a potential age-specific steeling effect in later life, since 'optimal' adversity was not associated with an increase of resilience resources, but rather the maintenance of a functional level of resources to effectively deal with adversity. Therefore, an 'optimal' level of adversity in higher age could support successful aging.

4.4 Summary Study 3: A qualitative study on successfully aged *Verdingkinder*

Aim: The study of life-long consequences of severe early-life adversities has received much attention from a pathological point of view. However, little is known about the potential development of positively-evaluated resources and their long-term effects on aging, which may originate within these adverse experiences. This study set out to examine the relationship between salutogenic developments in response to early adversity and successful aging with a sample of successfully aged former indentured child laborers in Switzerland (*Verdingkinder).*

Methods: Participants who were evaluated to be 'successful agers' were included in the study. Semi-structured interviews were conducted that lasted 60 – 120 minutes with twelve former Verdingkinder, mean age: 71 years, 6 men and 6 women. The interviews were analyzed using the paradigm model of the Grounded Theory.

Results: The most reported adversities were physical and emotional neglect and abuse, social isolation, discrimination, oppression, as well as a lack of education and self-fulfillment. Several enduring salutogenic developments were reported that were triggered in response to these experiences. These occurred either in direct relation (convergent development) or in contrast (divergent development) to what they experienced. Three main factors derived, which were associated with successful aging: 'lightheartedness including effective stress-management', 'social purpose', and 'self-enhancement'. Several intervening factors and underlying processes such as motivation, reflection, personality traits, social support, individual coping strategies, and turning points for these effects were reported.

Discussion: The identified factors show similarities with known predictors of well-being in higher age. Thus, under certain circumstances early and prolonged adverse experiences can provide the opportunity to develop resources for successful aging. The study shows the necessity to investigate risk and protective factors during and after prolonged adverse experiences for a better understanding of potential salutogenic trajectories.

5. GENERAL DISCUSSION

This thesis focuses on a potential crucial addition to the 'sick-care' or 'deficit-oriented' model that still dominate the health care system (Shonkoff et al., 2012; Zoellner & Maercker, 2006): Instead of viewing adversity as having only negative effects that need to be treated after they have developed, adversity can, under the right circumstances, also have resilience and well-being protecting and promoting effects. It was therefore the overarching aim of this thesis to provide further evidence for the salutogenic effects of adversity and to raise the awareness of such effects for science and praxis.

This chapter provides a general discussion of the thesis' findings in light of the theoretical background and recent scientific publications in the field. What has already been discussed in each respective paper will not be included in detail here and can be read in the appendix. This discussion will also include further analyses of the project data. Subsequently, the limitations of the project and implications for future research and praxis will be discussed.

5.1 Salutogenic effects of adversity and underlying mechanisms

'Optimal' adversity

The aim of the first paper was to derive a better description of 'optimal' or 'moderate' adversity and evidence for its positive outcomes. This was done by reviewing the empirical literature on curvilinear investigations of the effects of adversity. The second related empirical paper investigated a potential age-specific function of 'optimal' adversity in later life.

The review was able to show that several theoretically proposed positive outcomes of adversity (see 2.4.6) could be empirically found and were most pronounced in individuals who reported a moderate level of experienced adversity (Höltge, Mc Gee, Maercker, & Thoma, accepted). Most prominently were a gain in resources (e.g., Coroiu, Korner, Burke, Meterissian, & Sabiston, 2016; McLean et al., 2013) and a desensitization to proximal stressors (e.g.,

Dooley, Slavich, Moreno, & Bower 2017; Hagan et al., 2014; Seery, Leo, Lupien, Kondrak, & Almonte, 2013). Similarly, a very recent study was also able to show that adults in midlife with a moderate amount of negative life events show the highest resilience compared to people with lower or higher levels of adverse experiences (McGinnis, 2018). Some studies also investigated more general well-being indicators such as quality of life, satisfaction with life or global distress and found that individuals who reported a moderate level of adverse experiences in the past showed the best outcomes (e.g., Höltge, Mc Gee, & Thoma, 2018; Seery, Holman, & Silver, 2010). Furthermore, one study could show that a moderate level of adversity can be associated with a faster recovery in psychopathological symptoms compared to lower and higher levels of the same adversity (Schnurr et al., 1993). Also, individuals with a moderate level of experienced adversity have been found to experience a stressor rather as a challenge than a threat (Moore, Young, Freeman, & Sakar, 2017; Seery et al., 2013). In addition, Study 2 was able to show that a moderate level of adversity can support the maintenance of resilience resources (Höltge, Mc Gee, Maercker, & Thoma, submitted). All in all, some but not all theoretically proposed positive effects of adversity could be identified through the review (see 2.4.6), and Study 2 of this thesis was able to show an additional effect of 'optimal' adversity.

However, the review points out two crucial shortcomings in the research on the salutogenic effects of adversity. First, there is no common, 'gold-standard' measure to assess adversity, or more generally stress. This might be due to the fact that 'stress' is an interactional process that encompasses many different factors which determine its outcomes (Epel et al., 2018). Almost each study was found to use its own measure independent of whether the subjective experience of one adversity (applied by 6 studies) or the effect of accumulated adversity (applied by 23 studies) was investigated. This resulted in different levels of 'optimal' adversity and therefore no clearer picture of 'optimal' adversity can be derived from the review. Also, studies that investigated linear as well as curvilinear models in relation to the severity of

a single traumatic adversity resulted in contradictory findings by finding significant curvilinear (Lechner et al., 2003; McCaslin et al., 2009; McLean et al., 2013), significant linear (Kleim & Ehlers, 2009; Kunst, 2010) and non-significant (Arpawong et al., 2016; Powell, Rosner, Butollo, Tedeschi, & Calhoun, 2003) effects. Therefore, the assumption of a 'moderate' traumatic adversity being best for growth remains to be proven in future studies. But what can be concluded so far is that an accumulative measure seems to be better able to identify salutogenic effects of an 'optimal' amount of adversity than only looking at a single experience. This is also in line with the *cumulative risk model* (Price & Hyde, 2009).

Second, the endeavors to show evidence for the salutogenic effects of 'optimal' adversity have led to the use of rather simplistic models in the empirical literature so far. Mainly curvilinear models between the level of adversity and an outcome have been applied without studying crucial mediating or moderating variables of this relationship. Only one study could have been identified which showed that the type of coping (problem-focused vs. emotion-focused) can influence if moderate adversity leads to positive or negative effects (Suvak, Vogt, Savarese, King, & King, 2002). Furthermore, Study 2 showed that age might influence the effects of an 'optimal' level of adversity, because it was related to the maintenance of resources in later life and not an increase as would be expected from the literature on 'optimal' adversity. Also, this study showed that satisfaction with life changed in the same manner as the resilience resources in response to specific levels of adversity. This gives an insight into why well-being indicators might change in a specific direction in response to adversity. Additional analyses of the HEAST data-set concentrated on further potentially mediating variables of the curvilinear relationship between adversity and well-being. For example, one analysis showed a curvilinear association between ELA and quality of life in later life, which was highest for individuals with a moderate level of ELA (Höltge et al., 2018). Mental as well as physical health were investigated as potential mediators of this relationship and only mental health showed a

curvilinear relationship with ELA (highest mental health at moderate levels of ELA), while a negative linear association between ELA and physical health was found. This might indicate that the same level of adversity can affect psychological and physiological resources differently. This parallels findings from a study with a sample of young adults (Brody et al., 2013). This study found that individuals who were characterized by high psychosocial resources in young adulthood while being raised in a risky environment during adolescence showed high allostatic load in later life. Furthermore, another study found similar physiological responses (hyporesponsiveness of HPA) to a stress test between low and high levels of maternal care in childhood, while they differed in their level of psychological resilience (Engert et al., 2010). The low maternal care group showed low and the high maternal care group high psychological resilience. A further analysis of the HEAST dataset revealed that a moderate level of ELA can be associated with better adaptive coping strategies which partially explains the curvilinear relationship between ELA and mental health in later life (Greiveldinger, 2017).

All in all, Study 1 and 2 support the assumption of an 'optimal' level of adversity for human development and well-being. Nevertheless, because of the few longitudinal studies such as Study 2 and the lack of more complex models and a common assessment of adverse experiences, a lot remains to be researched.

While Study 2 makes important contributions to the theory on 'optimal' adversity, it also contributes to the literature on SA in later life. First, this study shows a potential way to support SA. As has been outlined in the theoretical background, a crucial aspect of SA in later life is to maintain resources at a functional level to do what is of value in life (Baltes & Baltes, 1990; Maercker, 2015; WHO, 2015). The findings of Study 2 show that some level of adverse experiences in later life might help to accomplish this goal.

Second, studies on the biopsychosocial development and well-being in later life usually find two general trajectories: either a stability or a decrease in different resources and well-

being to different degrees (e.g., Chang, Lu, Lan, & Wu, 2013; Wickrama, Mancini, Kwag, & Kwon, 2012). While Study 2 also found a decrease and a stability group in relation to central resilience-resources and satisfaction with life, also a group with an increase in all of these factors was found, which was characterized by the highest level of experienced adversity. This indicates that a positive development in the sense of improving one's resources is possible in later life, but a higher level of adversity than moderate might be necessary to elicit such developments.

A potential explanation might be that higher age has been related to a pronounced resilience (Levine, Laufer, Stein, Hamama-Raz, & Solomon, 2009; Netuveli & Blane, 2008). It needs to be kept in mind that a significant age effect was found which indicated that younger individuals showed the tendency to belong to the increase group and the older individuals to the maintenance group. When taking a lifespan perspective at SA this might indicate that increasing age is associated with increasing resilience because of increasing experiences of adversity (Aldwin, 2007; Knight et al., 2000). Therefore, the successfully aged person might have developed a sufficient resilience over the lifespan so that adversities of almost any kind can be successfully handled in higher age and rather serve the need to keep resources functional (see 2.4.4). This further indicates that just as there are limits in physiological performance, there might also be limits for the improvement of psychological resources (Carver, 1998), but maybe in the sense that there is no need for further improvements.

Severe childhood adversities

The aim of the third study was to get an insight into how severe childhood adversity might support successful aging in later life and how positive effects can arise out of such experiences (Höltge, Mc Gee, Maercker, & Thoma, 2018). For the purpose of this study, selected individuals from the Swiss subpopulation of former indentured child laborers, known as *Verdingkinder* (VK), were interviewed who were identified as successful agers. Because of the enduring

manifold barbarous conditions the former VK had to experience (Leuenberger & Seglias, 2008), their time as a Verdingkind (*Verdingung*) can be seen as a chronic severe adversity. Such adversities are usually associated with lasting negative outcomes (see 2.2), which has also been repeatedly found in investigations with former VK (Burri, Maercker, Krammer, & Simmen-Janevska, 2013; Kuhlman, Maercker, Bachem, Simmen, & Burri, 2013; Küffer, O'Donovan, Burri, & Maercker, 2016).

Nevertheless, the interviewed successfully aged former VK mentioned several positive outcomes which they traced back to their Verdingung. Many of the reported outcomes relate to the growth concept (Tedeschi & Calhoun, 2004), such as for instance personal strength or appreciation of life, and they reported highly resilient fundamental assumptions about the world. But two positive outcomes emerged that are not explicitly covered by the growth concept. First, their adverse man-made experiences translated into benefits for others. Growth encompasses a higher value of personal social relationships for oneself, but not pronounced altruistic behaviors for significant others and strangers. This development could be subsumed under the facet *seeing new opportunities in life*, but that would presume an independent, self-responsible life before the Verdingung, which was not the case for the interviewees. Second, the internal motivation or need for a life-long self-enhancement and fulfillment as a consequence of severe ELA is also specific to this population. These results are reflected by a recently published study on successful aging in older adults who had to live with a low socio-economic status throughout their life (Kok, van Nes, Deeg, Widdershoven, & Huisman, 2018). Even though they were interested in how their participants were able to age successfully *despite* and not *because of* their experienced chronic adversity and looked for resilience factors that supported successful aging in their sample, they also found altruistic behaviors, self-enhancement, and personal strength. However, in the way their participants reported these factors, the factors could have also been the result of their harsh living conditions. Therefore,

Study 3 adds to qualitative studies on growth that also point to context-specific salutogenic effects of severe adversity (e.g., Duran, 2013; Shakespeare-Finch & Copping, 2006).

Furthermore, Study 3 adds to the existing literature on motivational abilities of former Swiss Verdingkinder who are in higher age today (Simmen-Janevska, Forstmeier, Krammer, & Maercker, 2015; Simmen-Janevska, Horn, Krammer, & Maercker, 2014). These past studies found further evidence for the potentially lasting negative effects of early-life adversity such as a lowered self-control or willpower (Simmen-Janevska et al., 2015; Simmen-Janevska et al., 2014), and a lowered conscientiousness and self-efficacy (Simmen-Janevska et al., 2014). In contrast, Study 3 showed that the Verdingung could also result in life-enriching motivational forces. Even though these 'negative' motivational developments could also be viewed from the perspective of adaptive calibration (Ellis & Del Giudice, 2014), future studies should take different facets of motivation into account to show potentially co-occurring negative and positive effects of the same adversity, or to find the underlying mechanisms that lead to rather lasting positive than negative motivational abilities.

Further, chronic adversities especially in childhood are among the most detrimental adversities and the literature on the salutogenic effects of adversity stresses the importance of relatively brief, intermittent adversities with enough time for recovery (see 2.4.6). However, according to the interviews, a closer look needs to be taken at chronic adversities, because the interviewed Verdingkinder reported different opportunities for recovery within their chronic adversity. Also, a basic level of internal resilience already during the Verdingung such as the motivation to not resign and to stay strong, as well as social support during that time were reported as important factors for positive effects in response to this chronic adversity. These factors have also been outlined in the theoretical background as being important in the case of severe adversity (see 2.4.5) and have also been found by Kok et al. (2018). A novel factor that has been found in Study 3 was the function of anti-role models for the occurrence of salutogenic

effects which might be specific for longer lasting man-made adversities. The interviewees reported that their perpetrators were one of the central sources for their motivation to become successful and loving, i.e., ‘a better person’, and to stay strong.

Also, as has been proposed by the growth concept, children should not be able to experience an adaptation of fundamental assumptions about the world, future and the self in response to severe early-life adversity (Tedeschi & Calhoun, 2004). Two observations in the reports of the interviews support this assumption. First, the positive developments that happened during the Verdingung were mainly related to finding and improving practical, context-specific coping strategies. Second, a further analysis of the interviews by a master-student pointed to the crucial importance of corrective experiences such as respective, caring relationships and positive turning-points such as an appearance on TV, which resulted in being respected by the community, after the end of the childhood labor (Revelly, 2017). Because of such experiences the interviewees where able to come to terms with their past and started to reflect their time as a Verdingkind which probably led to the rebuilding of fundamental assumptions. Being acknowledge or respected by the community was also found by Kok et al. (2018) as a central factor for SA.

In sum, this study shows that factors which are known to be important predictors of successful aging such as resilience, education and social activity, can be the result of the experience of and coping with severe ELA.

5.2 Limitations of the present thesis

The major limitation concerns a selection bias of participants. Both empirical investigations studied individuals in later life who possessed a rather high health and well-being status. With respect to Study 2, the participants reported rather high values in the investigated variables (and therefore a high resilience) which might have led to the more or less low variance in change of the investigated variables. The reason for this selection bias might be ascribable to the

description of the study aims to potential participants. With respect to Study 3, an inclusion of a pathologically and normatively aged group of former VK might have given a clearer insight into which factors are crucial for successful aging in this specific population.

A second limitation of the empirical studies relates to their retrospective design which might question the genuineness of the salutogenic effects. In case of the longitudinal study, the participants had to remember their experienced adversities within the past year at the second assessment and how stressful these events were experienced. The past time since an experience might have led to a different evaluation of its severity at the second assessment as compared to the in situ experience (Hardt & Rutter, 2004), and the members of the 'Increase' group might have still been in a state of illusionary than genuine growth (Zoellner & Maercker, 2006). Concerning the qualitative study, the interviewees were asked to remember adversities of their childhood and the factors during and after their Verdingung that might have led to salutogenic developments in response to their ELA. But maybe because the Verdingung was already long ago (60-70 years) and the interviewees were characterized by a rather high health status, this might speak for genuine salutogenic developments (Zoellner & Maercker, 2006).

A further limitation of Study 2 is related to the operationalization of the experienced adversity. The participants might have experienced further personal significant and formative adversities that were not captured by the given event list. Additionally, significant positive events can also have formative salutogenic effects (Mangelsdorf & Eid, 2015; Roepke, 2013) and/or neutralize the effects of adversities (Revelly, 2017), which might have confounded the study results. Further, more psychological indicators for the severity of an adversity as outlined in section 2.4 might have provided better possibilities to differentiate between adversities. Related to this issue, asking the participants about the 'stressfulness' of an adversity might have been biased by especially male gender-stereotypes for some of the researched generations with respect to disclosing individual vulnerability (Höltge, Maercker, & Thoma, 2017).

5.3 Implications for future research

Based on the results of the current thesis, this chapter provides recommendations for future research with respect to outcomes, predictors and underlying mechanisms, and the operationalization of experienced adversity and study design. Before these recommendations are given, a self-created working model is presented that aims to synthesize the different approaches as outlined in sections 2.4.3 and 2.4.4 together with the results of Study 2. This model might help to derive a common theory of the genuine salutogenic effects of adversity in future research which should encompass the full quantitative range (i.e., severity) in relation to the subjective appraisal of an adversity.

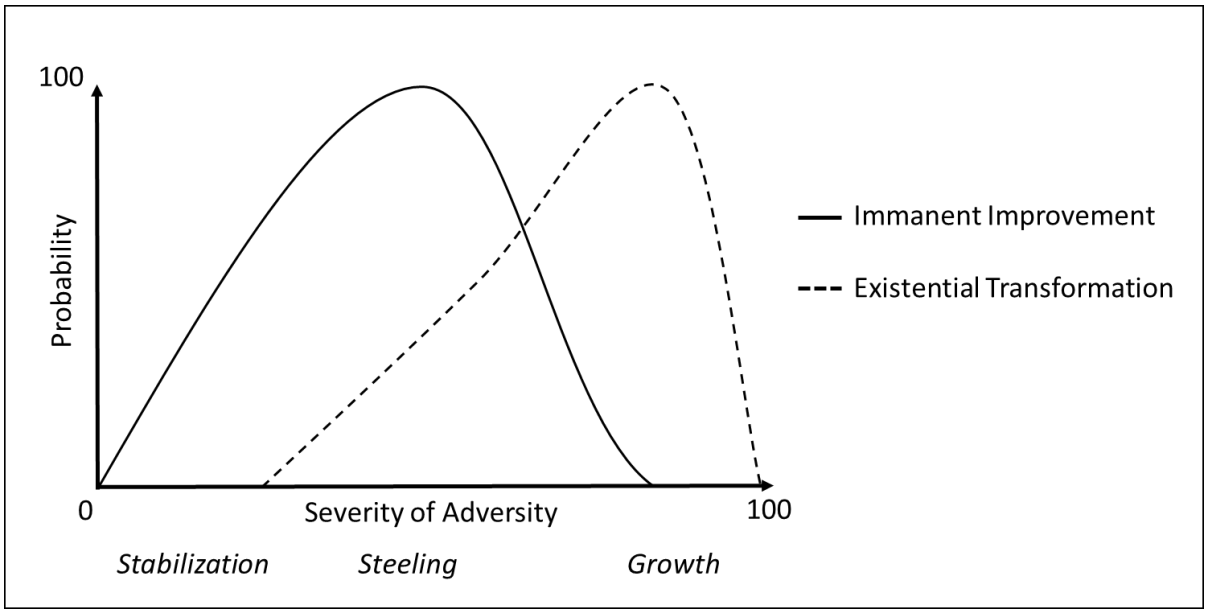
A working model for the genuine salutogenic effects of a single adverse experience

Two main forms of potential genuine salutogenic effects of adversity can be derived from the literature that can be differentiated by the subjective severity of an adverse experience in conjunction with the subjective ability to cope in-situ: *immanent improvement* and *existential transformation* (see Figure 1). Additionally, three types of positive effects that are related to the two forms can be inferred from the literature and Study 2: *stabilization*, *steeling*, and *growth*.

Immanent improvement relates to one of the main distinctions between the introduced constructs in the literature (see 2.4.2-2.4.4) and differentiates *stabilization* and *steeling* from *growth*: immanent improvement relies on the assumption that an individual that is affected by a low to moderate adversity has available resilience resources for that situation in order to successfully deal with it in situ (Rutter, 1987, 2012). Therefore, the resources that are used to cope are the obvious resources that improve, an inference from conditional adaptation (Boyce & Ellis, 2005). This is not the case for severe, potentially traumatic, life-disrupting adversities, since these are overwhelming which implies that appropriate resources to deal with the situation are not available, but only enough resilience to survive (Tedeschi & Calhoun, 2004; Janoff-

Bulman, 2004; Zoellner & Maercker, 2006). Therefore, as long as an adversity is too overwhelming to permit coping, coping will take place in the aftermath of the adversity.

Figure 1. Forms and types of genuine salutogenic effects of adversity.



Note: Probability = probability for the occurrence of the two forms dependent on the severity of an adverse experience.

Stabilization relates to the confrontation with 'minor' adversity and leads to resource-specific developments, which should not influence other resources (Rutter, 2012). Based on the results of Study 2, stabilization differs from steeling because it should happen in circumstances of more lower-level adversity and does not improve resources to be more effective, or only very little, but approves their effectivity and helps to maintain resources at a functional level (DiCorcia & Tronick, 2011). Further, stabilization should not be accompanied by negative effects such as feelings of vulnerability or threat, but rather with positive emotions because of the most likely experienced self-efficacy.

Steeling, as it has been described in more detail in section 2.4.3, relates to an improvement of context-specific as well as broader endogenous resilience resources in response to a personally highly significant adversity (Dienstbier, 1989; Liu, 2015; Rutter, 2012). These

developments are most pronounced when experiencing an ‘optimal’ level of adversity which relates to a ‘moderate’ level of adversity in quantitative terms that suggests that experiencing a higher and lower level of adversity would have less positive effects (DiCorcia & Tronick, 2011; Fergus & Zimmerman, 2005). From a developmental perspective (see 2.4.6), steeling is associated with gradual improvements of resilience resources in response to adversity.

Existential transformation is most likely when being confronted with a personally highly significant overwhelming, life-disrupting adversity that has shattered one’s fundamental assumptions about the future, world and the self in it, a “massive expectancy disconfirmation” (Janoff-Bulman, 2004, p. 32), as well as crucially impedes central life goals (Tedeschi & Calhoun, 2004; Zoellner & Maercker, 2006). Protection of significant resources is not possible and therefore some kind of negative loss is almost inevitable, which makes it impossible to return to one’s pre-event existence (Zoellner & Maercker, 2006). Life can therefore be separated into a before and after an event. Hence, such adversities can lead to sudden transformations on an existential level, which is not the case for single lower-level adversities. In relation to the growth concept (see 2.4.4), existential transformation especially relates to the creation of new, more realistic fundamental assumptions about the world, the future and oneself, as well as the re-evaluation and re-prioritization of what is of value in life, a higher conscious appreciation of (everyday) life and one’s own existence.

Outcomes

A crucial decision for the study design and interpretation of the data is to choose, what kind of positive effects are of interest (see 2.4.1). Are context-sensitive positive effects of interest then also potentially negative developments might need to be interpreted as positive adaptations, dependent on the demands of the situation (Bush, Obradović, Adler, & Boyce, 2011; Ellis & Del Giudice, 2014). If genuine salutogenic effects are of interest then functional as well as cultural norms need to be considered.

Furthermore, additional positive outcomes to the outcomes already assessed by empirical studies should be considered in future research. First, more research is needed that shows if dysfunctional resources, which have been evaluated as functional before an event, are voluntarily lost in response to adversity and maybe replaced by other equally or better functioning resources (Hobfoll, 2001). With respect to growth and overwhelming adversity, loss is related to inevitable losses of highly significant resources and the loss or shattering of dysfunctional fundamental assumptions. But also in such cases, resources could be voluntarily abandoned that did not help in times of suffering such as materialistic values (Kok et al., 2018). However, the review has shown that no study has yet investigated voluntary losses in response to 'optimal' adversity which is per definition not associated with involuntary losses (see 2.4.3).

Second, as the review and chapter 2.4.3 and 2.4.4 have shown, most of the research on the salutogenic effects of adversity is concerned with improvement. But as Study 2 has found, adversity can also serve to maintain resources at a specific level. Therefore, just as 'optimal' physical exercise for optimal fitness improvement and the development of the immune system by the confrontation with a specific dose of pathogens via vaccination are used as metaphors to describe the resilience-enhancing effects of 'optimal' adversity, the case that some level of ongoing physical exercise and repeated vaccinations are needed to maintain optimal functioning of the respective systems points to the possibility that the same might be true for psychological resilience resources such as self-efficacy or sense of coherence (see 2.4.3).

Related to this is the question if there is a limit of psychological improvement in response to adversity as it is the case for the improvement of physiological performance (Carver, 1998). But rather than looking for a limit it might be a more adequate approach to look at the circumstances a person lives in and the potential need for further adaptations.

Third, the distinction between divergent and convergent salutogenic effects of adversity might benefit future studies where researchers decide about the outcomes of interest.

Convergent developments relate to more or less expected effects of an adversity, such as the finding and improvement of functional coping resources as crucial characteristics of resilience. The notion of divergent developments makes aware of salutogenic effects which might not be expected in the first place, such as high altruistic values and behaviors in contrast to long lasting experiences of oppression, stigmatization, rejection, and/or emotional and physical neglect and abuse such as in the case of the interviewed former VK.

Fourth, next to their often severe negative effects, man-made adversities such as the Verdingung can result in strong personal and societal benefits. Altruism and volunteering activities in social domains have been found as strong predictors of personal well-being (Post, 2005; Rowe & Kahn, 1997). Therefore, future research should place a specific emphasize on the processes that lead to such kinds of salutogenic effects of adversity.

Finally, while this thesis was concerned with salutogenic effects of adversity on the individual level in psychological terms, future research should take a multi-systemic perspective. On the individual level this relates to taking into account psychological as well as physiological indicators. Allostatic systems also adapt to psychosocial adversities (Boyce & Ellis, 2005; Ellis & Del Giudice, 2014) and there might also be an 'optimal' level for their development which is being researched under the terms *toughness* (Dienstbier, 1989, 2015) and *hormesis* (Mattson, 2008; Stebbing, 1982). The question that arises from the literature (e.g. Höltge et al., 2018; Brody et al., 2013) is if there exists the same optimal level of adversity for both psychological and physiological salutogenic effects. Additionally, depending on the extent of the impact of an adversity, it could not only lead to salutogenic effects for the individual (which is the main focus of research), but also on a community or societal level such as in the case of terrorism (Park & Lechner, 2006; Vázquez, Pérez-Sales, & Hervás, 2008). All these different levels, from micro to macro, should be interdependent and therefore influence each other in their potential outcomes (Liu et al., 2017; Masten, 2014; Ungar, 2011).

Predictors and underlying mechanisms

In the case of longitudinal studies and experiments, this thesis has shown that factors that should significantly predict how an adversity is experienced and dealt with, and its potential outcomes are the individual pre-event resilience resources and former experiences of adversity which have formed the pre-event resilience. Resilience is a multi-systemic construct (see 2.3) and therefore it is necessary to assess biopsychosocial as well as ecological resilience resources and their interaction among each other and with a given adversity. Furthermore, it is necessary to not only assess the potentially available resources, but also if a person is able to access them and successfully utilize them (Aldwin, 2007; Ungar, 2011).

Furthermore, two contrasting theoretical positions in the literature on the salutogenic effects of adversity also show the need to account for resilience on different levels in one study. According to Hobfoll (2001), individuals with the highest resilience or highest amount of functional resources have the highest possibility for positive effects in response to adversity. This is contrasted by theoretical assumptions of growth (Bonanno, 2005; Tedeschi & Calhoun, 2004) and steeling (Liu, 2015) which assume a rather 'moderate' level of resilience in order to be significantly affected by an adversity, to perceive the need for an adaptive change, and to have room for development (see 2.4.5). Also, a study that has investigated potential linear and curvilinear relationships between the level of experienced adversity in the past and the level of growth in response to a recent formative negative event found that individuals with the lowest number of past adversity showed the most growth (Arpawong et al., 2016). Even though there is no information about the participants' resilience resources in this study, a low level of adverse experiences would indicate a low preparedness, i.e., resilience to adversity according to the topic of this thesis (Bonanno et al., 2010). This would heighten the possibility to experience an adversity as rather overwhelming and the experience of a more pronounced growth under the right circumstances. Therefore, the latter theoretical assumption might at least be more

plausible in the domain of growth. Nevertheless, Hobfoll's (2001) assumption might take effect when considering different levels of resilience resources and the severity of adversity. According to Ungar (2016), the successful coping with more severe adversities relies rather on socio-ecological resources and more minor adversities rather on individual-level resources. Therefore, a high level of socio-ecological resources accompanied by a low to moderate level of internal resources might underlie more pronounced salutogenic effects of more severe adversities on internal resources. Future studies are needed that test this potential interaction.

A further implication for future research relates to the potential short-coming of Study 2 which did not find a decrease in the investigated variables as a consequence of too extreme adversity where successful coping is not possible anymore even in its aftermath. This might be because the sample consisted of potentially high resilient individuals. The existence of this group would have indicated that the level of adversity to maintain resources is lower than the level to improve resources. Accordingly, 'optimal' adversity would only be related to a change since 'optimal' adversity as it is currently defined calls for an adaptation because of the recognition of vulnerability. But this appraisal should not be the case for the level of adversity that is needed to maintain resources. Therefore, future studies should strive for a high variability in the resilience of their participants.

This line of thought may question the significant age effect in Study 2, because the classic function of 'optimal' adversity might still count in higher age, but maybe only in interaction with the aging status of the individual. Individuals who are not successful agers might also benefit from 'optimal' adversity in higher age to reach successful aging.

Furthermore, the role of a self-reflective 'steeling' mind-set should be investigated in future research (Rutter, 2012). This relates to cognitive processes of evaluating the functionality of resources to deal with adversity and the attitude that adversities can also have beneficial effects. A closely related mind-set is captured by the *Sense of Coherence Scale Revised* (SOC-

R; Bachem & Maercker, 2016; Mc Gee, Höltge, Maercker, & Thoma, 2017) which assesses the degree to which a person believes that negative experiences are a normal part of life and that negative experiences inherit opportunities for self-improvement.

Finally, the novel finding of Study 3 in relation to the role of anti-role models as an important factor for the occurrence of salutogenic effects in response to rather severe, chronic man-made adversities calls for its verification in other man-made adversities. Also, the intervening factors that have been found in Study 3 for the occurrence of salutogenic effects during earlier periods of life should be further investigated if they also help other so far pathologically aged victims to get closer to successful aging.

Operationalization of experienced adversity and study design

A central issue that has been identified in this thesis is the missing 'gold-standard' empirical assessment of adversity. This makes it so far complicated to get a better understanding of 'optimal' adversity in the case of single as well as accumulated events. A measure needs to be implemented that can account for the full range of adversity, from minor to extreme adversities that do not even allow for existential transformation to occur. Several central indicators have been outlined in the theoretical background that might be sensitive enough.

In the case of a single adverse experience, the psychological factors of appraisal of the situation (challenge, threat, loss) in conjunction with the evaluation of the coping efficacy in situ should be considered. Research is used to assess the experience of challenge and threat as opposite poles in psychological as well as physiological terms (Blascovich & Tomaka, 1996; Moore et al., 2017; Seery et al., 2013; Tomaka, Blascovich, Kibler, & Ernst, 1997). But 'optimal' adversity has been described as a mixture of a challenge and threat, because something significant is at stake and could be harmed or lost which should result in the motivation to prevent the loss and protect resources (threat), and the demands of the situation are at the outer limits of one's coping capacities and therefore the person should still be able to

successfully cope with the situation (challenge) (see 2.4.3). A potential psychological approach would be the use of the *cognitive appraisal ratio* which seems consistent with the transactional stress model and conservation of resources theory (Tomaka et al., 1997). While it has been used to differentiate between threat (ratio > 1) and challenge (ratio < 1), a ratio that would be close to 1 might indicate the experience of an 'optimal' adversity. This subjective measure could be extended by a more objective measure of experienced stress by assessing the number of significant resources that are threatened or lost as a result of an adversity (Hobfoll, 2001). Also, the underlying motivation could be assessed to differentiate between the motivation for protection and prevention (threat) vs. gain (challenge). 'Optimal' adversity should be characterized by the motivation to protect in the first place, but the motivation for gain can co-occur at later stages (see 2.1.2 and 2.4.3).

Furthermore, according to the *cumulative risk model* it is necessary to assess the accumulated effect of adversities (Price & Hyde, 2009). Also from a developmental perspective, a premise for lasting positive effects is the repeated exposure to 'optimal' adversity (Fergus & Zimmerman, 2005). This has been the main approach in the research on 'optimal' adversity so far by assessing the frequency of different pre-determined adversities either in a given limited time period or over the entire lifespan, but without assessing the severity of each adversity (see Study 1). More or less individual event lists have been applied in this domain. Therefore, a first step would be the implementation of a 'gold-standard' instrument that assesses the same events and the subjective and objective experience of each event within a specific time period. Related to this issue, the *Stress Measurement Network* of the University of California, San Francisco, has very recently started international collaborations in order to provide a more standardized psychological assessment of stress in research (https://stresscenter.ucsf.edu/). They provide an overview of existing measures for stress and develop new measures that are in

line with up to date theories on stress. They provide event lists for specific topics like work, trauma or childhood, and also lifetime adversity measures, among others.

Further, the elicited emotions by adversity could be assessed. ‘Optimal’ adversity should be characterized mainly by negative, but also positive emotions because of the combination of threat and challenge (see 2.4.3). Lower level adversities should be associated with an increasing dominance of positive affect because the possibility to successfully cope gradually increases. Higher level adversities should mainly be associated with negative emotions in situ, because the possibility to successfully cope gradually decreases and therefore resources cannot be protected. But in the aftermath of an overwhelming adversity, positive emotions might play a crucial role for the occurrence of growth as well (Zoellner & Maercker, 2006).

Furthermore, the significance of an adverse event is an important indicator of how much a person is affected by an adversity and motivated to become more resilient (see 2.4.5). This could be assessed via the *Centrality of Event Scale* (Berntsen & Rubin, 2006). But other dimensions need to be taken into account according to the theoretical outlines of steeling and growth, since the significance of the situation should not noticeably differ between the two. One already outlined approach is the possibility for successful coping in situ which is only possible in the context of ‘optimal’ adversity or lower levels of adversity. A potential further approach might be the concept of *existential confrontation* (Maercker, 1995). ‘Optimal’ adversity affects at least one to potentially some personally significant resources, but the person is still able to deal with it and therefore should only be partially affected on an existential level. In contrast, overwhelming adversity inevitably affects fundamental, broad existential resources, i.e. core beliefs of one’s existence (Cann et al., 2008) and questions central life goals and values (Maercker, 1995), which should lead to a high existential confrontation. Existential confrontation, i.e., how severe fundamental resources are affected, could be assessed via the *Core Beliefs Inventory* (CBI; Cann et al., 2009).

The challenge for future research will be to design a feasible longitudinal study that accounts for the subjective and objective experience, and the accumulated pathological and salutogenic effects of different adversities. Because of the amount of experienced adversities within a given time span, a diary study in combination with an experience sampling would probably be an adequate approach. The experience sampling could be combined with physiological measures that indicate if a person is in a stress state and also potential periods of recovery could be assessed. Such a study needs to be as long as it takes that also genuine growth can be found and to investigate the effects of genuine growth on subsequent traumata.

Summary

The research on 'optimal' adversity is still at its beginning and a crucial initial step for future research on this kind of adversity is to choose 'gold-standard' measures to assess the accumulated effects of experienced adversities. Furthermore, it is crucial to assess the pre-event resilience on multiple levels as well as the acute-stress response. All of this is necessary to investigate the potential different salutogenic effects of different severe adversities in the sense of immanent improvement and existential transformation. But future research should not only concentrate solemnly on the salutogenic, but should equally consider the pathological effects of adversity. Hence, a context-sensitive (subjectively and culturally) longitudinal study needs to be conducted that simultaneously investigates the positive and negative multi-systemic short- to long-term effects of a wide spectrum of quantitatively and qualitatively different adversities, which takes the subjective and objective experience of and coping with adversities into account.

Further, three central issues need to be addressed in future empirical research. First, why and how can a too low level of adversity lead to a potential decrease in resilience and well-being? Second, longitudinal research is needed that shows the resilience-enhancing effects of existential transformation. Third, how should individuals, communities and societies interact for multi-systemic salutogenic effects?

5.4 Practical Implications

This thesis does not underscore the importance of the psychopathological view on adversity, nor does it see the salutogenic perspective as its opponent. Rather, it aims to encourage practitioners and policy makers to respect both, because adversity can lead to both and salutogenesis is linked to pathogenesis and symptom relieving interventions in the case of overwhelming adversity.

The main message of this thesis for public health programs as well as therapeutic interventions is that almost any kind of adversity (except no or too low adversity and adversity that cannot be coped with) can lead to genuine salutogenic effects and support successful aging from a lifespan perspective. If coping is possible and supported, this can lead to a gradual increase in resilience and in turn positively influence well-being and quality of life. This does not only benefit the individual, but also the society and health-care system. The 'right' amount of adversity can support mental health (Höltge et al., 2018), decrease health care utilization (Seery, Leo et al., 2010), prevent suicidal behavior (McLafferty et al., 2018), or increase adaptability (Suvak et al., 2002), and more severe adversities can lead to altruistic behaviors (Study 3). Therefore, next to initiatives that try to prevent adverse experiences, additional initiatives should be implemented that help to elicit salutogenic effects in the case of inevitable adversity. While pathological effects are inevitable if a person does not cope, salutogenic effects rely on active efforts and resources which need to be available and utilizable (Aldwin, 2007). This does not only rely on the individual, but also on its society (Ungar, 2011), especially in the case of overwhelming adversity (Ungar, 2016).

The support of salutogenic effects in response to inevitable adversity and the fostering of a 'steeling mind set' (Rutter, 2012) should start as early in life as possible (Aldwin, 2007), rather than being over-protective (DiCorcia & Tronic, 2011; Ungar, 2004) and 'sick-care' oriented (Shonkoff et al., 2012).

More practically, while adversity describes situations that would rather be avoided, having a superordinate positive goal might help to elicit the motivation to deal with an adverse situation (Blascovich, 2013). Further, while 'optimal' adversity is related to a high approach motivation because something significant is threatened and needs to be protected, the additional suggestion of a gain might further heighten this motivation (Blascovich, 2013). A best-practice example under controlled conditions is exposition as an intervention for phobias: a person is confronted with an adverse situation that would be avoided in daily life, but should be manageable in the therapeutic setting. Through progressive confrontations, the person should become more and more able to deal with the stressor. The motivation might be caused by the superordinate positive goal to erase the anxiety and to increase quality of life.

In relation to motivation, the study on the successfully aged former VK has shown that the conscious motivation or attitude to not resign, to not give up hope and to stay strong might be a crucial aspect that supports salutogenic effects of adversity and its importance might increase with increasing severity. This endurance or persistence has been found in other studies of longer lasting adversities to be of crucial importance for positive outcomes (Chen & Miller, 2012) and should also rely on higher-order positive goals (Frankl, 1959).

Additionally, just as research needs to be aware of adaptations that could be positive in a given context, but outside of this context or from a normative perspective they would be regarded as maladaptive, practitioners also need to be aware of this context-specificity. Accordingly, instead of trying to elicit adaptations in the person that could not fit the current context, adaptations of the personal environment might be a more adequate approach as first steps before trying to elicit genuine salutogenic effects in the person (Hobfoll, 2001).

Thus, while this thesis does not want to motivate a voluntary seeking of adverse situations, it rather wants to encourage to use the opportunities inherent in inevitable adversities as stepping stones for the progress of individuals and societies.

6. GENERAL CONCLUSION

This thesis provides the first contribution to the scientific research of adversity by giving a more systematic illustration of the potential salutogenic effects of almost any severity of adversity. Further, it adds to the aging literature by showing the potential successful aging supporting effects of adversity experienced in early and later life and potential underlying mechanisms of this relationship.

The theoretical background (see 2.4) and working model in the discussion (see 5.3) of this thesis provide a synthesis of different theoretical approaches that have more or less separately investigated the salutogenic effects of adversity. Hence, it gives an insight into the potential different and similar mechanisms that underlie the salutogenic effects of different levels of adversity. It shows that the overall positive contribution of adversity to human well-being, functioning and development lies in its resilience-enhancing effects when successful coping occurs. Resilience-enhancement relates to beneficial changes in resilience resources and existential transformations. The first paper provides first systematic evidence for the different salutogenic effects of 'optimal' adversity and therefore emphasizes the potential necessity of a specific level of adverse experience for optimal human development, well-being and functioning. The second paper provides first evidence that a specific level of adversity in later life might be necessary to maintain central psychological resilience resources in higher age and therefore might be an important factor for successful aging. The third paper shows important factors and processes that make successful aging in the face of chronic, severe childhood adversities possible.

Future research on the effects of adversity is asked to look at pathological as well as salutogenic processes and outcomes of this experience from a multi-systemic perspective. Further, future studies are encouraged to not only look at positive developments *despite*, but also *because of* adverse experiences on the individual and societal level.

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8. APPENDIX

8.1 Publications

8.1.1 Manuscript 1: A salutogenic perspective on adverse experiences: The curvilinear relationship of adversity and well-being

By Jan Höltge[1,2], Shauna L. Mc Gee[1,2], Andreas Maercker[1,2], & Myriam V. Thoma[1,2]

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Abstract

Research has predominantly focused on the negative effects of adversity on health and well-being. However, the salutogenic perspective suggests that adversity may not always be detrimental (Antonovsky, 1996). In fact, under certain circumstances, adversity may have the potential for positive outcomes, such as increased resilience and thriving (Carver, 1998; Rutter, 1987). The 'steeling effect' suggests that past experiences of adversity may increase resistance to later adversities. It proposes that moderate adversity may facilitate more adaptive functioning than no adversity or high levels of adversity (Rutter, 2006; 2012). The relationship between adversity and health may be optimally assessed using curvilinear models, yet the majority of previous studies have examined linear associations (Masten & Cicchetti, 2016). It is therefore the aim of this review to determine whether moderate adversity is associated with more adaptive functioning when compared to no and high levels of adversity. Practical implications and future research are also discussed.

Keywords: systematic review; steeling effect; resilience; thriving; curvilinear.

Introduction

Research on the consequences of adversity has long been defined by its traditional focus on the negative effects on health and well-being. Experiences of adversity have frequently been shown to be associated with the development of physical and psychological disorders (e.g., Kessler et al., 2010; Scott et al., 2011). The predominant and fundamental assumption of such research is that there is a negative linear dose-response relationship between the extent of adversity experienced and health.

This linear dose-response relationship relates to the potential stress sensitizing effect of adverse experiences. This suggests that adverse experiences can lower the threshold to stress and heighten vulnerability to subsequent stress and adversity (McLaughlin, Conron, Koenen, & Gilman, 2010; Post, 1992; Rutter, 2012). In the beginning, stress sensitization can be initiated by severe adversities, but with ongoing adverse experiences, increasingly minor stressors can be sufficient for the sensitization to continue (Monroe & Harkness, 2005; Smid et al., 2012). Therefore, stress sensitization is likely to occur in circumstances where an affected individual is unable to successfully cope with a situation, particularly in the case of chronic adversities (Rutter, 2006; 2012). For instance, results from a longitudinal study with pre-schoolers found that prolonged early-life stress can lead to a heightened biological sensitization, which in turn can lead to a higher probability of developing mental health problems in later life (Essex, Klein, Cho, & Kalin, 2002). Similarly, further studies on early-life stress have shown that the more early-life stress an individual has experienced, the less stress is required to influence the onset of depression in later life (Hammen, Henry, & Daley, 2000; Harkness, Bruce, & Lumley, 2006; Shapero et al., 2014). On the basis of the stress sensitization assumption, it follows that the more severe and the higher the number of lifetime adversities, the more negative is the expected impact on health and well-being (Norman et al., 2012). Conversely, this would suggest that no experiences of adversity should lead to optimal health.

However, this assumption is challenged by the recurring finding that not all individuals who experience stress or adversity go on to develop psychopathology or impaired physical health (e.g., Maercker, Hilpert, & Burri, 2016). This heterogeneity of responses to adversity can be understood in relation to the salutogenic model of health (Antonovsky, 1979). Unlike the pathological model of health, which focuses on the causes of disease, the salutogenic model views health in terms of a movement along a continuum between health and disease. It proposes that through the use of or health-promoting or 'salutary' resources and coping strategies, individuals have the capacity to overcome adverse experiences and even thrive through adversity (Antonovsky, 1987). According to this salutogenic perspective, adverse experiences may not always be detrimental to health. Under certain circumstances, adversity may even have the potential for positive well-being outcomes by providing an opportunity for successful coping (Antonovsky, 1996).

With regard to the potentially positive effects for health and well-being, it is important to differentiate between two related, yet distinct outcomes: 'resilience' and 'thriving'. Resilience refers to the ability to adapt and recover from adverse experiences and attain pre-adversity, baseline levels of functioning (Bonanno, 2004; Bonanno, Westphal, & Mancini, 2011). However, thriving goes beyond resilience and is defined as the attainment of a higher level of adaptive functioning, superior to the pre-adversity level of functioning (Carver, 1998; O'Leary & Ickovics, 1995). This parallels research from different disciplines, which suggest that humans have an innate drive or force to thrive in the face of adversity (Richardson, 2002).

Thriving has been discussed in the literature using various related concepts and theories. Some concepts relate to the underlying phenomenon of positive effects in response to negative experiences in general, such as 'resilient reintegration' (Richardson, 2002), 'adversarial growth' (Linley & Joseph, 2004), and 'stress-related growth' (Park, Cohen, & Murch, 1996). Other concepts relate to positive effects and increased resilience due to an 'optimal' level of

adversity, such as the 'steeling effect' (Rutter, 1987), 'stress inoculation' (Meichenbaum, 1993), 'toughness' (Dienstbier, 1989), and 'immunization' (Garmezy, 1986); as well as the more widely-known 'posttraumatic growth', which is specifically concerned with traumatic experiences (Calhoun & Tedeschi, 2006). Emerging research on the potential for thriving following adversity is challenging the traditional negative linear dose-response assumption between adversity and health by applying nonlinear assumptions and models. These nonlinear models propose the existence of an 'ideal' level of adversity or stress for optimal human development and well-being. From here on, this response will be referred to under the overarching term of the steeling effect.

The steeling effect suggests that past experiences of adversity may increase resistance to later adversities through a 'steeling' or strengthening effect (Dienstbier, 1989; Garmezy, 1986; Meichenbaum, 1993; Rutter, 1987). Comparisons have been drawn to the functioning of the immune system, which develops through the adaptation to demanding but manageable stress experiences (Rutter, 2012). In contrast to stress sensitization, it suggests that the effects of adversity are nonlinear rather than linear, in that exposure to some or 'moderate' adversity may result in more adaptive functioning than exposure to no or severe adversity (Dienstbier, 1989; Liu, 2015; Rutter, 2006; 2012). Severe adversities may excessively overwhelm the individual to that point that they are unable to cope with the adversity, while no or minimal adversities may not pose a sufficient challenge to stimulate the development of coping abilities or resources (Dienstbier, 1989; Fergus & Zimmerman, 2005; Rutter, 1987). In contrast, exposure to moderate stressors is suggested to be sufficiently challenging that it can be successfully coped with and in doing so individuals can gradually learn and improve their coping skills for subsequent exposures to adversity (Fergus & Zimmerman, 2005). Thus, moderate stressors provide a context within which individuals can apply and train resilience resources (Fergus & Zimmerman, 2005).All in all, while moderate adversity should theoretically lead to increased

resilience and adaptability and decreased sensitivity to future stressors, no or severe adversity may lead to a heightened stress sensitization (Liu, 2015; Rutter, 2012).

Theoretically, 'moderate' adversity can refer to the amount of experienced adversity within a defined time span, as well as the subjective and objective appraisal of an adverse event. According to the steeling effect theory, moderate adversity is sufficiently challenging as it provides the opportunity to practice coping skills and to develop and utilize resources, which may facilitate thriving and enhance coping abilities for future adversity (Bonanno & Diminich, 2013; Fergus & Zimmerman, 2005; Lazarus & Folkman, 1984; Liu, 2015; Rutter, 1987; Seery, 2011). In the literature, 'challenges' are often compared to 'threats/hindrances' in their effects on human well-being and development (Cavanaugh, Boswell, Roehling, & Boudreau, 2000; Lazarus & Folkman, 1984; LePine, LePine, & Jackson, 2004; LePine, Podsakoff, & LePine, 2005). Challenges are considered to be related to positive emotions. It is proposed that challenges should result in a high motivation to deal with a stressor, as they are associated with a high possibility for successful coping and subsequent positive outcomes (Lazarus & Folkman, 1984; LePine et al., 2005). In contrast, threats/hindrances are associated with negative emotions and potential harm for personal well-being and development (Lazarus & Folkman, 1984). Threats/hindrances may therefore lead to a low motivation for coping, in order to reserve resources for potential future challenges for which there may be a greater possibility for successful coping (LePine et al., 2005). However, if an individual is motivated to cope with a significant threat in order to prevent negative outcomes from an adversity, this could be re-appraised as a challenge due to the involvement of the coping process (Lazarus & Folkman, 1984). Furthermore, challenges and threats/hindrances may occur at the same time (Lazarus & Folkman, 1984). What all these stressors have in common is that they require energy, i.e., a short-term depletion of resources, in order to cope with an adversity, which leads to the experience of stress (Hobfoll, 2001; Van den Broeck, De Cuyper, De Witte, & Vansteenkiste,

2010). The resources to cope with such stressors can come from within the individual, as well as from the socio-ecological environment (Richardson, 2002; Ungar, 2012). However, from the literature it can be seen that a main difference which differentiates between these stressors is that in the long term, threats/hindrances deplete resources and may lead to lasting and severe negative effects, such as a higher stress sensitivity and vulnerability to pathology, if the affected person is unable to successfully deal with the adversity (Hobfoll, 2001; LePine et al., 2005; McLaughlin et al., 2010). In contrast, although challenges test individual stress limits, they can also be viewed as opportunities for growth as they can be successfully coped with under the right circumstances, which is a crucial mechanism of thriving (Folkman & Lazarus, 1985; Hobfoll, 2001; Rutter, 2012). This can result in an increase in resilience and functionality (Rutter, 2012). For example, a recent longitudinal study of 208 working adults found that an increasing number of challenging stressors at work can lead to an increase in resilience. Whereas an increasing number of work-related hindrance stressors leads to a decrease in resilience and an increase in experienced strain three months later (Crane & Searle, 2016).

Hence, moderate adversities are comparable to challenges in that they are also suggested to provide the opportunity for growth (following successful coping efforts). In addition, moderately adverse experiences are defined as brief and intermittent, with sufficient possibilities for recovery of depleted resources and rest for consolidation of new resources (Carver, 1998; Dienstbier, 1989; Liu, 2015; Rutter, 1987). In sum, moderately adverse events may be characterized by being perceived as challenging, motivate to actively cope and have a high chance to be successfully coped with, are timely limited, provide the opportunity to respond to the situation and to recover from it. Overall, this demonstrates that the traditional negative linear dose-response assumption between adverse experiences and well-being is challenged by the theoretical assumption of favourable outcomes following the experience of

moderate adversity. This suggests that the effects of moderate adversity would be better assessed using curvilinear (i.e., nonlinear) rather than linear models (Liu, 2015).

Some research has been conducted on nonlinear models and the steeling effect using prospective studies with animals (e.g., Lyons & Parker, 2007; Parker & Maestripieri, 2011). Despite this, the majority of empirical studies on thriving following adversity have tested linear associations, which were often conceptualized based on cumulative risk models and gradients (Masten & Cicchetti, 2016). These designs may have obscured the variation and effects of differing levels of adversity on well-being, producing contradicting findings (Meyerson, Grant, Carter, & Kilmer, 2011). However, research on nonlinear models of adversity are emerging in line with advances in the statistical strategies and data collection techniques required to assess these effects (Masten & Cicchetti, 2016).

It was therefore the aim of this study to systematically review the empirical evidence on the steeling effect to determine whether moderate adversity is associated with more adaptive functioning when compared to no and severe levels of adversity. Given that moderate aspects of adverse experiences appear to be a central feature for the steeling effect, particular focus was given to the methodical implementation of moderate adversity (i.e., curvilinear models of adversity and well-being outcomes). The evidence for the steeling effect will first be evaluated in studies using nonlinear models of analysis. This will be followed by a discussion of the implications of the steeling effect for positive well-being, with directions for future research, and concluding remarks.

Method

A systematic review was conducted following the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement (Liberati et al., 2009). The following online databases were included in the search: PsychINFO, Pubmed, and Scopus. In

addition, the reference lists of relevant articles were also manually screened for eligible studies and forward citation searching was conducted on the final articles identified for inclusion in the review. Search terms related to the following three domains were used for the literature search: adverse experiences (e.g., adversity, abuse), severity of an adversity (e.g., exposure, perception), and thriving (e.g., steeling, growth, toughness). The complete review protocol can be found in the online supplement.

Inclusion criteria

Potential studies were those published in the English language, in peer-reviewed journals, until March 8th, 2018. In addition, the following eligibility criteria had to be fulfilled: (a) quantitative and/or qualitative empirical method; (b) assessment of the severity of adversity, and (c) assessment of indicators of thriving. The severity of an experience could be indicated objectively by adversity specific measures (e.g., cortisol levels, cancer stages), or subjectively by the appraisal of the experience (e.g., emotional level, such as fear experienced during the event). Thriving refers to improvements in adaptive functioning following experiences of adversity. Indicators of thriving could be any positive development or adaptation in a person's life in relation to one or more negative events. Such indicators could be measured retrospectively, longitudinally, or experimentally.

Exclusion criteria

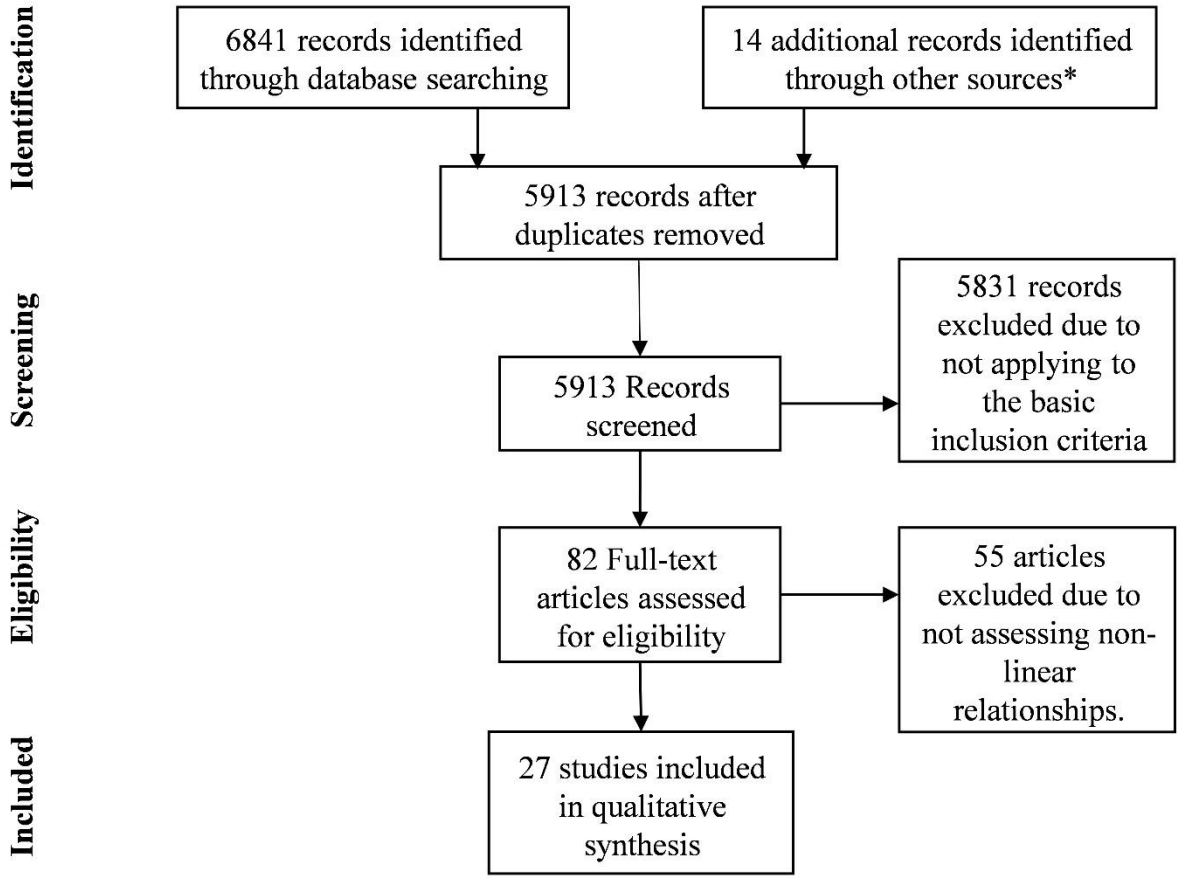
Studies that did not examine nonlinear relationships were excluded. In addition, animal studies and studies focusing on pathology rather than thriving were excluded.

Procedure

Each stage was conducted by two researchers (please see Figure 3 for an overview) and in the case of contrasting selections or uncertainty, the researchers discussed these articles and agreement was reached. The initial database search returned 6841 articles. After removing

duplicates 5899 articles remained. The titles and abstracts were then screened according to the inclusion criteria, which resulted in 71 remaining empirical articles. The full-texts of these articles were then read and 58 additional articles were removed as they did not assess curvilinear relationships. This resulted in 13 studies. Additionally, the reference lists of these 13 articles, as well as topic-related reviews and meta-analyses (e.g., Linley & Joseph, 2004) were then manually screened to identify any additional relevant articles. This resulted in 7 additional studies for inclusion in the review. As a final step, forward citation searching was also conducted to identify any further articles. Using Web of Science (Thomson Reuters), articles were identified which had cited the 20 studies already selected for the review. This search resulted in a total of 1106 articles returned. After removing duplicates and screening according to the inclusion criteria, 7 additional studies were added, resulting in a total of 27 studies for inclusion in the review (see TABLE 1 for details of the studies).

Figure 2. Flow diagram of the study selection process with reasons for exclusion.



Note * These 14 studies encompass 7 studies found via reference lists and topic-related reviews and meta-analyses as well as 7 studies found via forward citation searching.

Table 1. Characteristics of the studies included in the review

Study	Design	Sample[a]	Type of adversity	Operationalization of adversity		Operationalization of thriving[b]	Results[c]
				Subjective measure	Objective measure		
Aldwin et al., 1994	Cross-sectional Survey	*N* = 1287 M_{age} = 63.6 (*SD* = 7.5)	War	Not assessed	*Frequency*: Combat exposure	Desirable and undesirable outcomes Posttraumatic Stress Disorder Depression	*Linear*: Most desirable (*r* = .33*) and undesirable outcomes (*r* = .17*), as well as highest PTSD (r = .15*) observed at high combat exposure
Arpawong et al., 2016	Cross-sectional Survey	*N* = 564 M_{age} = 18.8 (*SD* = .9)	Most life altering event of past 2 years	Not assessed	*Frequency*: Stressful life events *Appraisal*: Severity of most stressful life event	Posttraumatic Growth	*Linear*: Highest PTG observed at the lowest number of stressful life events (β = -.09**)
Bush et al., 2011	Cross-sectional Survey	*N* = 338 M_{age} = 5.3 (*SD* = 0.3)	Socio-economic status, family stress	Not assessed	Index of family stress (indicated by parents) Index of socio-economic status (indicated by parents)	Chronic basal cortisol in fall and spring	*Curvilinear*: Highest cortisol levels observed at moderate levels of family stress in spring (β = -.109*) *Curvilinear*: Lowest cortisol levels observed at moderate socio-economic status in fall (β = .16*) *Linear*: Highest cortisol levels observed at high family stress in fall (β = .126*) *Linear*: Highest cortisol levels observed at low socio-economic status in spring (β = -.184**)
Coroiu et al., 2016	Cross-sectional Survey	*N* = 193 M_{age} = 55.1	Breast cancer	*Appraisal*: General stress *Appraisal*: Cancer stress	Not assessed	Posttraumatic Growth	*Curvilinear*: Highest PTG observed at a moderate level of general stress (β = -.22, ΔR^2 = .05**)

Dooley et al., 2017	Cross-sectional Survey	*N* = 122 M_{age} = 58.9 (*SD* = 11)	Lifetime acute and chronic stress	Not assessed	*Frequency*: Acute and chronic lifetime stress	General negative and positive affect Cancer-related intrusive thoughts	*Curvilinear*: Lowest frequency of intrusive thoughts (β = .01, ΔR^2 = .04***) and highest positive affect levels (β = -.01, ΔR^2 = .03**) observed at a moderate frequency of acute stressors *Linear*: Lowest negative affect levels observed at a low frequency of acute (β = .19, ΔR^2 = .06*) and chronic (β = .29, ΔR^2 = .14*) stressors
Edge et al., 2009	Cross-sectional Survey	*N* = 97 M_{age} = 21.6	Early life stress	Not assessed	*Frequency*: Family stress in childhood	Present implicit and explicit anxiety	*Curvilinear*: Lowest implicit anxiety levels observed at a low frequency of early life stress (ΔR^2 = .09**) *Linear*: Lowest explicit anxiety levels observed at a low frequency of early life stress (ΔR^2 = .05**)
Finch & Obradović, 2017	Cross-sectional Survey Different tasks	*N* = 102 M_{age} = 5.6 (*SD* = .6)	Socio-economic and emotional challenges	Not assessed	Index of socio-economic challenges (indicated by parents) Index of parental emotional challenges (indicated by parents)	Executive functioning: Cognitive control in (a) emotionally neutral contexts (cool CC) and (b) motivationally- and emotionally- significant contexts (hot CC) External evaluation of executive functioning of the child	*Curvilinear*: Highest levels of cool CC (β = -.105*/-.111*, ΔR^2 = .03*) and best external evaluation (β = -.135*, ΔR^2 = .05*) observed at a moderate level of emotional challenges *Linear*: Highest levels of hot CC observed at a high level of emotional challenges (β = .358**, ΔR^2 = .03*)
Fontana & Rosenheck, 1998	Cross-sectional Survey	*N* = 1198 M_{age} = 40.1 (*SD* = 5.3)	War	*Appraisal*: Perceived threat to oneself	*Frequency*: Fighting, killing, death/injury of others, atrocities	Self-improvement, affirmation of patriotic beliefs, solidarity with others, psychological benefits overall Disillusionment of patriotic beliefs, overall psychological liabilities	*Curvilinear*: Highest levels of solidarity observed at a moderate level of perceived threat* *Linear*: Highest levels of self-improvement** and psychological benefits overall*** observed at high levels of death of others *Curvilinear*: Highest disillusionment observed at a moderate level of death of others*

Gunnar et al., 2009	Experiment Survey Trier Social Stress Test	N = 124 M_{age} = 11.3 (SD = 0.7)	Time-point of adoption in early childhood	Not assessed	Appraisal: Control group (no adversity), early adopted (moderate adversity), late adopted (severe adversity)	Cortisol reactivity to test	*Curvilinear*: Lowest cortisol reactivity observed at a moderate level of adversity*
Hagan et al., 2014	Experiment Survey Role play task	N = 91 M_{age} = 18.7 (SD = 1)	Interparental conflicts during childhood	*Appraisal*: Intensity of perceived interparental conflicts in childhood	*Frequency*: Perceived interparental conflicts in childhood	Average cortisol activity during task Cortisol reactivity to task	*Curvilinear*: Lowest average cortisol activity (β = -.01, ΔR^2 = .06**) and cortisol reactivity (β = -.02, ΔR^2 = .04*) observed at a moderate frequency of interparental conflict *Linear*: Lowest average cortisol activity (β = .04**) observed at a low intensity of interparental conflict
Höltge et al., 2018	Cross-sectional Survey	N = 193 M_{age} = 65.1 (SD = 8.7)	Early-life adversity	Not assessed	*Frequency*: Childhood abuse and neglect	Quality of life Mental health Physical health	*Curvilinear*: Highest levels of quality of life (β = -.59, ΔR^2 = .03**) and mental health (β = -.67, ΔR^2 = .03**) observed at a moderate frequency of early-life adversity *Linear*: Highest levels of physical health (β = -.18**) observed at a low frequency of early-life adversity
Jennings et al., 2006	Longitudinal Survey	N = 615 M_{age} = 74 (SD = 6.8)	War	Not assessed	*Frequency*: Combat Exposure	Wisdom Alienation	*Linear*: Highest levels of alienation observed at any frequency of combat exposure compared to no exposure* *Curvilinear*: Highest levels of wisdom (p = .056, ΔR^2 = .007) observed at moderate combat exposure
Kleim & Ehlers, 2009	Longitudinal Survey	N = 180 M_{age} = 35.1 (SD = 11.4)	Assault	*Appraisal*: Peritraumatic Emotions (fear/shock, shame/humiliation)	Not assessed	Posttraumatic Growth	*Linear*: Highest PTG observed at high levels of fear/shock (β = .24**) and shame/humiliation (β = .22**)

Kunst, 2010	Longitudinal Survey	N_{t1} = 678 N_{t2} = 205 M_{aget1} = 39.8 (SD_{t1} = 14.8) M_{aget2} = 44.2 (SD_{t2} = 15.8)	Violence	*Appraisal*: Peritraumatic Distress	Not assessed	Posttraumatic Growth	*Linear*: High PTG observed at high levels of peritraumatic distress (β_{t1} = .25*, β_{t2} = .20*)
Lechner et al., 2003	Cross-sectional Survey	N = 83 M_{age} = 62.5 (SD = 12.4)	Cancer	Not assessed	Cancer stage I-IV	Posttraumatic Growth	*Curvilinear*: Highest PTG observed at a moderate level of cancer (stages II and III; β = -1.7, ΔR^2 = .1*)
McCaslin et al., 2009	Cross-sectional Survey	N = 93 M_{age} = 21.6 (SD = 1.3)	Most distressing lifetime event	*Appraisal*: Peritraumatic Distress *Appraisal*: Peritraumatic Dissociation	Not assessed	Posttraumatic Growth	*Curvilinear*: Highest PTG observed at a moderate level of peritraumatic dissociation (β = -.4, ΔR^2 = .1**)
McLafferty et al. 2018	Cross-sectional Survey	N = 1164 M_{age} = 47	Childhood adversity	Not assessed	*Frequency*: Childhood risk factors	Mental health problems Suicidality in response to experienced trauma	*Curvilinear*: Lowest suicidality observed at a moderate level of childhood risk*** *Linear*: Highest mental health problems observed at high levels of childhood risk***
McLean et al., 2013	Cross-sectional Survey	N = 253	War	Not assessed	*Frequency*: Job stress exposure *Frequency*: Combat stress exposure	Posttraumatic Growth Posttraumatic Stress Disorder	*Curvilinear*: Highest PTG observed at a moderate level of combat stress (ΔR^2 = .06**) and job stress (statistics missing) *Linear*: Highest PTSD observed at a high level of combat stress***
Moore et al., 2017	Experiment Survey Dart-throwing task	N = 100 M_{age} = 21.9 (SD = 5)	Lifetime adversities	Not assessed	*Frequency*: Cumulative lifetime adversity	Cardiovascular response (challenge vs. threat response to task) Task performance	*Curvilinear*: Best cardiovascular response (ΔR^2 = .09**) and task performance (ΔR^2 = .09**) observed at a moderate level of lifetime adversity
Powell et al., 2003	Cross-sectional Survey	N = 136	War	Not assessed	*Frequency*: Traumatic events during war	Posttraumatic Growth	No effects

Ruch et al., 1980	Longitudinal Survey	*N* = 138	Life-change events	Not assessed	*Frequency*: Life-change events before rape experience	Negative impact of rape experience at crisis intake and follow-up	*Curvilinear*: Lowest negative impact at crisis intake (β = .27*) and follow-up (β = .26*) observed at a moderate frequency of life-change events
Schnurr et al., 1993	Cross-sectional Longitudinal Survey	*N* = 540 M_{age} = 39.8	War	Not assessed	*Frequency*: combat exposure	Psychological problems in college and adulthood after the war experience	*Cross sectional*: *Curvilinear*: Lowest levels of psychological problems observed at a moderate frequency of combat exposure in adulthood* *Longitudinal*: *Curvilinear*: Fastest decrease in psychological problems observed at a moderate frequency of combat exposure*
Seery, Leo, et al., 2010	Cross-sectional Survey	*N* = 396 Med_{age} = 54.5	Lifetime adversities	Not assessed	*Frequency*: Cumulative lifetime adversity	Functional impairment Healthcare utilization	*Curvilinear*: Lowest levels of functional impairment***, disabled employment status*** and healthcare utilization** observed at a moderate frequency of lifetime adversity
Seery et al., 2010	Cross-sectional Survey	*N* = 2,398 M_{age} = 49.3 (*SD* = 16.1)	Lifetime adversities	Not assessed	*Frequency*: Cumulative lifetime adversity	Global distress Functional impairment Life satisfaction Posttraumatic stress symptoms	*Curvilinear*: Lowest levels of global distress***, functional impairment***, PSS*** and highest life satisfaction*** observed at a moderate frequency of lifetime adversity
Seery et al., 2013	Experiment Survey *Study 1*: Cold pressor task *Study 2*: Nonverbal intelligence test)	Study 1: *N* = 147; Study 2: *N* = 216	Lifetime adversities	Not assessed	*Frequency*: Cumulative lifetime adversity	*Study 1*: Situational catastrophizing, pain intensity, unpleasantness, immersion time, negative Affect; *Study 2*: cardiovascular index for resilience (challenge vs. threat response to task)	*Study 1* *Curvilinear*: Lowest levels of catastrophizing (sr^2 = .047**), pain intensity (sr^2 = .051**), pain unpleasantness (sr^2 = .027*) and negative affect (sr^2 = .063**) observed at a moderate frequency of lifetime adversity *Study 2* *Curvilinear*: Best cardiovascular response observed at a moderate

							frequency of lifetime adversity (sr^2 = .039)**
Suvak et al., 2002	Cross-sectional Survey	*N* = 408	War	Not assessed	*Frequency*: Combat exposure	Post-War: Achievement, life satisfaction, lifetime adaptation Note: The aim was to explore at what level of combat exposure is the association between a positive development and a specific coping strategy highest	*Curvilinear*: Problem-focused coping leads to the highest achievement (β = -.3*) and lifetime adaptation (β = -.23*) at a moderate frequency of combat exposure *Curvilinear*: Emotion-focused coping leads to the lowest achievement at a moderate frequency of combat exposure (β = -.22*)
Wildman & Johnson, 1977	Cross-sectional Survey	Study 1: N = 156 Study 2: N = 237	Life-change events	Not assessed	*Frequency*: Experienced life-change events	Psychological distress	*Study 1 & 2* *Curvilinear*: Lowest levels of distress observed at a moderate frequency of life-change events* ($Eta^2_{\text{Study 1}}$ = .084, $Eta^2_{\text{Study 2}}$ = .113)

Note *M* = Mean, *Med* = Median, *SD* = Standard Deviation, PTG = Posttraumatic Growth, PTSD = Posttraumatic Stress Disorder, CC = cognitive control, *Frequency* = adversity has been operationalized via a cumulative amount of different adversities. *Appraisal* = adversity has been operationalized via a measure to indicate the subjective or objective appraisal of a single adversity.

[a] Not all studies reported the mean and/or standard deviation for age.

[b] Some studies assessed more potential dependent variables (e.g. McCaslin et al (2009) also assessed PTSD), but did not analyze curvilinear relationships in relation to the severity of the studied adversity. Therefore, these have not been included.

[c] If available, standardized coefficients and any type of effect size are reported for linear and curvilinear effects. β = standardized regression coefficient (in case of curvilinear effect: β = U-shaped, -β = inverted U-shaped), ΔR^2 = change in the explained variance of the outcome when only the curvilinear predictor is added to the model, Eta^2 = how much variance in the outcome is explained by the predictor, sr^2 = how much

variance of the outcome is uniquely explained by the predictor, *Linear*: only a linear relationship has been found between the variables, *Curvilinear*: a curvilinear (quadratic) relationship has been found between the variables. This does not exclude that a linear relationship has been found between the variables, but only the curvilinear relationship needs to be interpreted in this case (Cohen, Cohen, West, & Aiken, 2003).

* $p < .05$, ** $p < .01$, *** $p < .001$

Results

Curvilinear models and 'optimal' levels of adversity for thriving

Thriving has been operationalized in the literature as increases in positive indicators of well-being (including posttraumatic growth) and psychophysiological resistance to proximal adversity, as well as decreases in negative symptoms or indicators of ill-health (including psychological and physiological health) and risk-factors of well-being.

Early evidence for a nonlinear association between adversity and health outcomes was shown in studies conducted with Vietnam War veterans. For instance, research by Schnurr, Rosenberg, and Friedman (1993) examined changes in psychological functioning (operationalized as desirable personality traits) from pre- to post- military service in 540 men. Results indicated that moderate or peripheral exposure to combat predicted improvements in psychological functioning, in comparison to individuals with no or direct (high) exposure to combat (Schnurr, Rosenberg & Friedman, 1993). Similarly, a study by Fontana and Rosenheck (1998) examined data from 1,198 veterans for positive and negative psychological effects of traumatic exposure in a war zone. Results showed a curvilinear trend in the form of an inverse U-shaped quadratic relationship between self-reported psychological benefits (particularly solidarity with others) and traumatic exposure. This curvilinear model indicated that psychological benefits were stronger at moderate levels of exposure in comparison to both high and low levels of exposure (Fontana & Rosenheck, 1998). More recent support for these findings can be seen in the research by McLean et al. (2013), which examined combat exposure and healthcare stress exposure (i.e., treating combat casualties in high-threat areas) in 253 medical personnel. In relation to posttraumatic stress disorder (PTSD), results showed a linear relationship with combat exposure, and a curvilinear relationship with healthcare stress exposure. However, with posttraumatic growth (as a resilience indicator), a curvilinear inverse U-shaped relationship was shown for both types of exposure, with moderate exposure

associated with the highest levels of posttraumatic growth compared to low or high exposure (McLean et al., 2013). A further study with 615 war veterans found a curvilinear trend between the amount of combat exposure and wisdom in higher age, with the highest levels of wisdom shown at a moderate amount of exposure (Jennings, Aldwin, Levenson, Spiro, & Mroczek, 2006). Similarly, another study with 408 war veterans investigated at what level of combat exposure is problem- and/or emotion-focused coping most beneficial for post-war development (Suvak, Vogt, Savarese, King, & King, 2002). Results found that problem-focused coping led to the highest achievements (e.g., educational, financial) and better lifetime adaptation at a moderate amount of combat exposure. In contrast, results also showed that emotion-focused coping led to the highest achievements at low and high amounts of exposure.

Further support for nonlinear associations was shown in a large-scale longitudinal study, which examined adversity and resilience (operationalized as positive health outcomes) in a nationally representative sample of 2,398 participants (Seery, Holman, & Silver, 2010). Results initially found linear associations, indicating that higher lifetime adversity was associated with more negative health outcomes. However, further analyses using quadratic associations revealed curvilinear (J- and U-shaped) relationships, such that individuals with some lifetime adversity reported lower functional impairment, lower global distress, fewer posttraumatic stress symptoms, and higher satisfaction with life than individuals with no or high lifetime adversity. Individuals with a moderate amount of past adverse experiences were also least negatively affected by recent adversity (Seery, Holman, & Silver, 2010). Similar results have been found by Wildman and Johnson (1977), and Ruch, Chandler and Harter (1980). Wildman and Johnson found a curvilinear association between the amount of experienced adverse life-events and psychological distress in a sample of college students and adults. Thus, participants with a moderate amount of adverse events reported the least psychological distress in their studies (Wildman & Johnson, 1977). Furthermore, Ruch et al. (1980) found that women with a

moderate amount of adverse experiences showed the least negative psychological impact of a rape experience, indicated by the women's reported emotions, behaviours and cognitions, at crisis intake and six months after the rape compared to women with a lower or higher amount of past adverse experiences. These results support the steeling effect theory, indicating that moderate adversity confers greater resilience (Rutter, 2012), and also suggest that the application of curvilinear models may reveal effects, which may not be detected with simple linear models (Seery, Holman, & Silver, 2010).

Curvilinear associations with resilience and thriving have also been assessed in studies with cancer patients. For instance, one study found that patients whose cancer severity was moderately life-threatening (operationalized as stage II) showed significantly higher levels of benefit finding (i.e., increased resilience and self-reliance, enhanced appreciation of life, improved relationships) than patients who had low or high levels of threat (Lechner et al., 2003). Similarly, recent research on perceived stress and posttraumatic growth in cancer patients also showed a curvilinear inverse U-shaped relationship, with moderate levels of perceived general stress associated with the greatest posttraumatic growth (Coroiu, Korner, Burke, Meterissian, & Sabiston, 2016). Expanding on this, research by Dooley, Slavich, Moreno, and Bower (2017) differentiated between acute and chronic stressors in assessing lifetime exposure and psychological functioning (i.e., cancer-related intrusive thoughts, and positive and negative affect) in 122 cancer survivors. Results showed that while chronic stress was linearly associated with negative affect, curvilinear associations were observed between the amount of acute stress exposure and both intrusive thoughts and positive affect. This suggests that moderate acute stress was associated with fewer intrusive thoughts and higher levels of positive affect in comparison to low and high acute stress (Dooley et al. 2017). However, the contradicting findings for acute and chronic stress warrant further research on the role of adversity type in fostering resilience and thriving, as well as the underlying mechanisms and processes involved.

Support for curvilinear models of adversity was also shown in experimental studies assessing responses to controlled laboratory stressors. One such study examined psychological and physiological responses to two types of stressors, a cold pressor task and an intelligence test (Seery, Leo, Lupien, Kondrak, & Almonte, 2013). Results showed U-shaped curvilinear associations in both tests, indicating that moderate lifetime adversity was associated with lowest levels of pain intensity, unpleasantness, negative affect, and cognitive catastrophizing, and more positive physiological responses, in comparison to no or high adversity (Seery et al., 2013). A more recent study examined the relationship between the number of lifetime adversities and the cardiovascular response and performance of 100 young adults during a competitive dart-throwing task (Moore, Young, Freeman, & Sarkar, 2017). Results showed better cardiovascular responses to the situation and task performances in participants with a moderate amount of lifetime adversity. Additionally, results of both studies suggested that participants with a moderate amount of lifetime adversity showed a cardiovascular response indicative of a challenge rather than a threat state in response to a demanding task. These findings further support the steeling effect theory and indicate that a moderate level of past adversity is associated with resilience to future stressors (Rutter, 2012; Seery et al., 2013).

Furthermore, research by Seery, Leo, Holman, and Silver (2010) demonstrated the practical applications of curvilinear models in a study on lifetime exposure to adverse experiences, functional impairment (chronic back pain), and healthcare utilization. Results showed significant U-shaped quadratic relationships for both outcome measures, indicating that participants with some lifetime adversity reported less impairment and healthcare utilization than participants with no or high lifetime adversity (Seery et al., 2010).

Some studies have also examined curvilinear models in relation to adverse experiences in childhood and psychobiological resilience and thriving in later life. Two studies examined associations between early-life stress and current response to stressors by measuring cortisol

activity after social stress tests. Early-life stress was indicated by duration of institutional care (Gunnar, Frenn, Wewerka, & Ryzin, 2009) and experiences of interparental conflict (Hagan, Roubinov, Marreiro, & Leucken, 2014). Results from both studies showed that children with a moderate amount of early-life stress had lower cortisol activity during the stress test compared to children with low or high levels of early-life stress. This suggests that moderate adversity early in life may have a protective effect during stressful situations in later life. A similar study of 338 children explored a potential curvilinear relationship between seasonal basal cortisol levels (during spring and fall) and early-life stressors, as indicated by family stress and the socio-economic status of the parents (Bush, Obradović, Adler, & Boyce, 2011). Results found curvilinear relationships between basal cortisol levels in spring and family stress, with the lowest cortisol levels observed at low and high levels of family stress. Curvilinear relationships were also found between basal cortisol levels in fall and socio-economic status, with the lowest cortisol levels observed at a moderate level of socio-economic status. A positive linear relationship was also found between basal cortisol levels in fall and family stress, as well as a negative linear relationship between basal cortisol levels in spring and socio-economic status. Regarding these contrasting curvilinear results, the authors suggest that the use of low or high levels of cortisol for successful adaptation depends on the respective demands of a situation. The authors further suggest that future studies should separately assess different types of adversities and not use a summary score for differing adversities.

Additionally, four studies examined curvilinear models in relation to early-life stress and psychosocial resilience and thriving in later life. Edge et al. (2009) examined the associations between family-related early-life stress and anxiety in later life. While early-life stress was linearly associated with explicit (self-reported) anxiety, a curvilinear association was shown for implicit (observed, behavioral) anxiety, such that moderate early-life stress was associated with lower implicit anxiety levels when compared to low or high early-life stress.

The contrasting results for implicit and explicit anxiety indicate the need for further research on adversity and the steeling effect using both objective and self-report indicators of resilience and thriving. Furthermore, a study with 102 children found better executive functioning in emotionally neutral contexts, as well as the highest external-rated executive functioning, in children who experienced a moderate amount of emotional challenges in early life (Finch & Obradović, 2017). This study also found a positive linear relationship between emotional challenges in early life and executive functioning in motivationally- and emotionally-significant contexts. No associations were found in relation to socio-economic challenges in early life. A very recently published study by McLafferty and colleagues (2018) investigated the longer-term effects of early-life stress on health in 1164 middle-aged adults. Results showed the lowest suicidality in individuals with a moderate amount of early-life stress. Another recent study examined the potential long-term positive impact of early-life stress on quality of life and health in 193 older adults (Höltge, Mc Gee, & Thoma, 2018). Results found the highest quality of life and mental health in individuals with a moderate amount of adverse childhood experiences. For physical health, a negative linear association was found between early-life stress and physical health in higher age. The relationship between early-life stress and quality of life was mediated by mental health but not by physical health.

Furthermore, one study investigated different indicators of the subjective experience of adversity and their relationship to posttraumatic growth in 93 young adults (McCaslin et al., 2009). While results showed a curvilinear association between peri-traumatic dissociation and posttraumatic growth, no such association was found for peri-traumatic distress. However, as has already been shown for some studies, not all studies using curvilinear analyses found significant effects. For example, an early study by Aldwin, Levinson, & Spiro (1994) examined the effects of combat exposure in early adulthood on mental health in late life in a sample of 1287 war veterans. They hypothesized an inverse U-shaped relationship between the level of

combat exposure and perceived benefits. However, results did not show this curvilinear relationship, but rather a positive linear association. In addition, four other studies which examined curvilinear effects between adversity measures and posttraumatic growth found no significant effects. One such study with 136 former war refugees found no significant association between the number of war-related experiences and posttraumatic growth (Powell, Rosner, Butollo, Tedeschi, & Calhoun, 2003). Furthermore, a study by Kleim and Ehlers (2009) with 180 assault survivors was unable to demonstrate a significant curvilinear relationship between a proxy measure of adversity, i.e. the emotions felt during the assault (e.g., fear/shock and shame/humiliation) and posttraumatic growth. However, this study did show positive linear associations between these emotions and posttraumatic growth. A similar result was found in the longitudinal study by Kunst (2010), with only positive linear associations observed between the perceived peri-traumatic distress and posttraumatic growth. Finally, a recent study by Arpawong et al. (2016) investigated the relationship between the severity of the most stressful life-event and posttraumatic growth in 564 high-school students. Results showed neither a curvilinear nor linear relationship between the measures. However, it was proposed that the perception or appraisal of an event as severe or adverse may have a greater influence on well-being than the actual severity of the event itself (Arpawong et al., 2016). This may account for the lack of significant findings in studies, which used an objective rather than subjective measure of adversity.

Positive linear associations were also found between the level of experienced adversity and mental health problems (McLafferty et al., 2018), physical health (Höltge et al., 2018), cortisol activity during a stress test (Hagan et al., 2014), basal cortisol level (Bush et al., 2011), explicit anxiety (Edge et al., 2009), and negative affect (Dooley et al., 2017) in later life. Furthermore, a study by Jennings et al. (2006) found equally high levels of alienation in war

veterans across all studied levels of combat exposure. These results support the sensitizing effect of stress.

In summary, while some studies provide evidence for the stress sensitization effect, most are in support of the steeling effect theory. That is, these studies showed that some or moderate adversity appears to be optimal for well-being and adaptive functioning, not only in comparison to high levels of adversity, but also when compared to no adversity. While further research is required, we can cautiously conclude at this point that the application of curvilinear models is appropriate for assessing the association between adverse experiences and positive well-being outcomes, such as resilience and thriving.

Discussion

'Optimal' adversity

Research on the steeling effect often refers to 'optimal' adversity as being 'moderate'. The review has shown that 'moderate' is usually operationalized in relation to the frequency, amount, or number of different adversities during a given time period such as lifetime (e.g., Dooley et al., 2017; Seery, 2013), childhood (e.g., Hagan et al., 2014; Höltge et al., 2018), or as different adversities that are part of an overarching adversity, such as war (e.g., Jennings et al., 2006; Powell et al., 2003). The second most common operationalization was the subjective (e.g., Coroiu et al., 2016; Kleim & Ehlers, 2009) and objective (Arpawong et al., 2016; Gunnar et al., 2009) appraisal of a single adversity, and the subjective appraisal of general stress (e.g., Coroiu et al., 2016; Hagan et al., 2014). In addition, two studies used individually-calculated indices, which combined frequencies, appraisals, or categorical variables, such as highest degree of education or household income (Bush et al., 2011; Finch & Obradović, 2017). The studies included in this review allow for the interim conclusion that operationalization as a 'moderate' number (i.e., frequency) of adversities is more likely to capture the 'steeling effect',

as opposed to ‘moderate’ appraisals, which were more likely to lead to no significant results or linear relationships.

In addition, despite the mixed results, curvilinear relationships were also found in the domain of posttraumatic growth (Coroiu et al., 2017; Lechner et al., 2003; McCaslin et al., 2009). This would contradict the steeling effect as, although the theory states that severe adversities should lead to negative effects, the results show evidence of optimal outcomes at ‘moderate’ levels of a severe adversity.

Furthermore, as almost every study used a different measure to assess the level of adversity, no clear statements can be made about the ‘optimal’ level of adversity. The few studies which used the same instruments to assess adversity and outcomes (Kunst, 2010; McCaslin et al., 2009) do not show consistent results. Furthermore, in their series of studies Seery and colleagues used the same measure to assess adversity and yet different results are reported for the ‘optimal’ amount of adversity for steeling to take place. For example, while the optimal amount of lifetime adversity was reported as 2-4 adversities in Seery et al. (2010), 3-6 adversities was reported as optimal in Seery et al. (2013). In addition, Moore et al. (2017) showed that the optimal amount can also depend on the outcome of interest. While the ‘optimal’ amount of adversity was 4-7 for cardiovascular response, it was 3-13 adversities for a task performance. Dooley et al. (2017) also showed large variation, as the ‘optimal’ amount for their outcomes was between 20-35 acute adversities, and no relations were found for chronic stressors. In sum, as long as there is no standardized measure to assess ‘moderate’ adversity, no clear statement can be made on the ‘optimal adversity’.

Implications for positive well-being and future directions

Research on the steeling effect has a number of practical implications for preventative actions and clinical interventions. For instance, individuals who have had severe experiences of adversity or trauma, or who have a high possibility for such experiences, are usually the target

of preventative or clinical actions. However, the research on curvilinear assumptions showed that individuals with no or minimal experiences of adversity, such as military personnel with minimal combat exposure (McLean et al., 2013), also reported negative effects on their well-being. Furthermore, children who grow up highly protected from any stress (i.e., the so-called 'helicopter parenting') tend to show higher levels of distress and maladaptive coping later on in life (Bayer, Sanson, & Hemphill, 2006). Such individuals represent an unrecognized, largely untreated, yet at-risk population (Liu, 2015). In addition, according to the steeling effect theory, minimal stressors may not be sufficiently challenging to necessitate or stimulate the development of coping strategies and resilience-related resources (Rutter, 1987; 2012). This implies that a lack of resilience resources and coping strategies may be as harmful to well-being as the negative experience itself. Therefore, one recommendation is the provision of interventions and preventative measures for individuals with minimal adversity focusing on the development of resilience-related resources and coping strategies.

With regard to moderate adversity, contrasting findings from the curvilinear analysis suggest that practical actions should not assume a 'one-fits-all' approach. Results from the study by Dooley et al. (2017) found evidence in support of a steeling effect for acute stress but not for chronic stress. Whereas Edge et al. (2009) found evidence of a steeling effect for objective anxiety but not self-report anxiety. Similarly, Arpawong et al. (2016) failed to detect evidence for a steeling effect using an objective measure of adversity. One explanation comes from research on posttraumatic growth by Zoellner and Maercker (2006), which suggests that different types of adversity may stimulate the development of different adaptation processes and abilities and that an individuals' appraisal or perception may play a role in this process. This is supported by a study by Boals and Schuettler (2011), which found that an individuals' appraisal of an adverse event as central to their identity was associated with improved psychological functioning, indicative of posttraumatic growth. Therefore, to successfully

promote and strengthen resilience in clinical as well as public health actions, it is important to consider individual differences in the appraisal of adversity and its influence on the development of effective coping abilities and resources (Lazarus & Folkman, 1984; Zoellner & Maercker, 2006).

Furthermore, the research on curvilinear associations highlights the significance of identifying moderating mechanisms underlying the steeling effect (i.e., the factors which facilitate the development of resilience and thriving following adversity), in order to implement successful programs. However, while the research on the steeling effect is increasing, there is still a lack of empirical studies on potential moderating factors. Only one study showed that the effectiveness of different coping strategies can depend on the severity of the adversity (Suvak et al., 2002). Nevertheless, by drawing on existing theoretical and empirical research on resilience, thriving, and posttraumatic growth, potential factors may be identified for further study. For instance, thriving and related constructs suggest that if individuals can learn from or positively adapt in response to a stressor, then they will be better prepared to handle future adversity. A crucial moderator for further study in this context is a thriving-supportive mind-set or attitude. One recommendation for this is sense of coherence, which is the ability to integrate and balance stressful life experiences in order to maintain and further develop health (Antonovsky, 1979; Bachem & Maercker, 2016). Furthermore, the personality trait of optimism has been shown to promote well-being in the face of adversity. In comparison to pessimistic and neurotic personality types, optimists have been shown to use more adaptive coping strategies such as active coping, taking proactive measures, and persistence in well-being efforts (Carver, Scheier, & Segerstrom, 2010; Zoellner & Maercker, 2006). Additionally, a number of cognitive factors, such as positive re-appraisal, problem-focused coping, self-reflection, and emotion regulation strategies have been shown to increase opportunities for resilience and thriving by reducing distress and focusing on the positive aspects and benefits of an adverse

situation (Liu, 2015; Zoellner & Maercker, 2006). Similarly, previous research suggests that a sense of mastery (i.e., feeling in control over one's life), self-efficacy, and self-confidence promote resilience and thriving by facilitating the use of active coping strategies and positive appraisal (Carver, 1998; Rutter, 2006). Rutter (2012) also proposed that biological mediators, such as changes in cortisol levels and HPA-axis activity (e.g., Gunnar et al., 2009; Hagan et al., 2014), should also be considered. Furthermore, the pre-event level of resilience itself might play a crucial role in thriving. For instance, a study by Kaye-Tzadok and Davidson-Arad (2016) showed that growth is highest at a moderate level of resilience. This is in line with theoretical considerations of the relationship between resilience and thriving, as resilient individuals may not feel the need to become more resilient; but having no resources can leave individuals feeling overtaxed and unable to recover (Calhoun & Tedeschi, 2006; Carver, 1998). The relationship between adversity and thriving is complex and likely influenced by numerous factors. Some studies have shown that the same adversity can show an advantageous curvilinear association and a disadvantageous linear association at the same time, in relation to different outcomes (Höltge et al., 2018; McLafferty et al., 2018). As no clear pattern can be identified from the studies in this review, which determines when an adversity leads to either a sensitizing or steeling effect, future research is required to examine these potential factors for their influence on the association between adversity and positive well-being outcomes.

Building up this, future research should also consider the context of adversity. For instance, the study by Dooley et al. (2017) examined different types of stressors and found evidence of a steeling effect for acute but not chronic stress. One explanation may be that the process of steeling can differ between various adverse circumstances. For example, context-sensitive steeling may occur in the form of a heightened resilience in response to a specific stressor (e.g., Ellis & Del Giudice, 2014); and cross-situational steeling may occur in the form of general heightened resilience (e.g., Seery, 2011). Furthermore, positive linear relations have

been shown between the level of adversity and positive outcomes (e.g., Finch & Obradović, 2017; Kleim & Ehlers, 2009). To better understand the potential positive outcomes of adversity, future studies should investigate the influence of different adversities on the steeling process.

However, the findings from the curvilinear analyses not only have implications for practice, but also for the methodological considerations and design of future studies. For instance, many of the studies in the review used retrospective, cross-sectional designs, limiting the ability to establish a temporal relationship or draw definitive conclusions about causality. Additionally, in retrospective studies individuals may be prone to recall bias (Frazier & Kaler, 2006). For example, research on the perception and validity of posttraumatic growth in retrospective studies showed that individuals may exaggerate perceived positive change in order to cope with distressing thoughts or feelings related to an adverse event (McFarland & Alvaro, 2000). This emphasises the importance of using objective, as well as subjective, indicators of resilience and positive development. Future research should therefore employ longitudinal study designs with objective and subjective measures to examine perceived and actual changes in resilience over time and in response to adverse experiences.

Research on the steeling effect also has broader implications with regard to healthcare services and policy directions. Instead of only trying to minimize stress or to protect people from stress and to target interventions only at cure, 'inevitable' stress could be used to build resilience when the coping is adequately supported by the society (Richardson, 2012; Ungar, 2012). The steeling effect shows that programs are needed that help people to experience their stress as 'moderate' or 'challenging'. For instance, identifying important resilience resources and moderating factors for thriving could improve the efficiency of clinical interventions. This could reduce extended reliance on healthcare services and result in lower healthcare costs. In support of this, one study using curvilinear models showed that the more resilient individuals reported the lowest utilization of healthcare services (Seery, Leo, Holman, & Silver, 2010).

Concluding remarks

The experience of stress has the capacity to sensitize individuals to future stressors, resulting in increased harm. However, it can also lead to the development of resilience and heightened well-being. This review summarized the emerging empirical research on the steeling effect and thriving, by evaluating the studies, which applied curvilinear analyses in assessing the impact of adversity. It was shown that under certain circumstances, the experience of adversity can have a positive effect on well-being, in that moderate adverse experiences can be seen to facilitate resilience and thriving. Continuing research is needed to identify the underlying mechanisms involved in the steeling effect. This can be achieved by employing curvilinear as well as linear models to get a more comprehensive view of well-being following adversity. The experience of adversity is an inevitable part of life and so it is of crucial importance to not only study its negative impact, but to also understand its potential for thriving.

Online Supplement: Search Terms

PsychINFO

Limiters

- English language
- Peer-reviewed Journal
- No scientific simulation

((((AB (adversity OR trauma OR abuse OR maltreatment OR stress)) OR (TI (adversity OR trauma OR abuse OR maltreatment OR stress)) OR (DE (adversity OR trauma OR abuse OR maltreatment OR "Psychological Stress"))))

AND

(((AB (severity OR exposure OR intensity OR characteristics OR involvement OR perception OR perceive* OR apprais*)) OR (TI (severity OR exposure OR intensity OR characteristics OR involvement OR perception OR perceive* OR apprais*)) OR (DE (severity OR exposure OR "stimulus Intensity" OR "profiles (measurement)" OR perception OR "cognitive appraisal")))))

AND

(((AB (thriving OR “positive change” OR “beneficial change” OR “posttraumatic growth” OR “post-traumatic growth” OR “adversarial growth” OR “stress-related growth” OR “benefit finding” OR toughness OR steeling OR inoculation OR immunization)) OR (TI (thriving OR “positive change” OR “beneficial change” OR “posttraumatic growth” OR “post-traumatic growth” OR “adversarial growth” OR “stress-related growth” OR “benefit finding” OR

toughness OR steeling OR inoculation OR immunization)) OR (DE (thriving OR “positive change” OR “beneficial change” OR “posttraumatic growth” OR “post-traumatic growth” OR “adversarial growth” OR “stress-related growth” OR “benefit finding” OR toughness OR steeling OR inoculation OR immunization OR “environmental adaptation” OR “emotional adjustment” OR “psychological development” OR “resilience (psychological)” OR “adaptability (personality)”))))

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(TITLE-ABS-KEY(adversity OR trauma OR abuse OR maltreatment OR stressor)) AND (TITLE-ABS-KEY(severity OR exposure OR intensity OR characteristics OR involvement OR perception OR perceive* OR apprais*)) AND (TITLE-ABS-KEY(thriving OR "positive W/1 change" OR "beneficial W/1 change" OR "posttraumatic W/1 growth" OR "post-traumatic W/1 growth" OR "adversarial W/1 growth" OR "stress-related W/1 growth" OR "benefit finding" OR toughness OR steeling OR inoculation OR immunization OR resilience)) AND (LIMIT-TO(DOCTYPE,"ar") OR LIMIT-TO(DOCTYPE,"ip")) AND AND (LIMIT-TO(LANGUAGE,"english")) AND (LIMIT-TO(SRCTYPE,"j"))

8.1.2 Manuscript 2: Underlying Mechanisms of Resilience: A Longitudinal, Person-Centered Investigation of the Positive Impact of 'Optimal' Adversity in Later Life

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Abstract

The *steeling effect* suggests that 'optimal' (moderate) adversity enhances resilience which underlies positive effects of adversity on well-being. The aim was to examine steeling in later life and factors contributing to resilience-enhancement. The sample consisted of N=187 participants (M_{age} = 67.32 years, SD = 8.54). A one-year longitudinal survey study was conducted. Socio-demographics, adversity experienced over the last year, resilience resources, and satisfaction with life were assessed. Latent profile analysis was used to identify profiles of change. BCH and R3STEP methods were applied to examine differences between the profiles. Three profiles emerged: decreased resources ('Decrease'), stability of resources ('Maintenance'), and increased resources ('Increase'). 'Decrease' was characterized by low, 'Maintenance' by moderate, and 'Increase' by high adversity. Age influenced profile membership. Satisfaction with life changed according to the change in resources. This study shows a potential age-specific steeling effect in later life, since 'optimal' adversity was associated with the maintenance of resilience resources.

Keywords: steeling effect; moderate adversity; operationalization

Introduction

Recent research on the effects of adversity calls into question the traditional psychopathological view of adversity. Rather than being merely a source of negative effects and a higher vulnerability for diseases and disorders (e.g., McLaughlin, Conron, Koenen, & Gilman, 2010), increased scientific interest is focusing on the phenomenon of positive effects and increased resilience due to the experience of adversity (Liu, 2015; Rutter, 2012). The underlying premise is that an 'optimal' level of adversity can lead to 'optimal' development and functioning (Liu, 2015). This phenomenon has been previously discussed in the literature under various terms, including *steeling* (Rutter, 2012) or *toughness* (Dienstbier, 1989). From here on, this phenomenon will be referred to as 'steeling' or the 'steeling effect'.

There are some parallels between the steeling effect and traditional views on the effects of adversity (e.g., *cumulative risk model*; Sameroff, 2000), as both approaches suggest that the worst outcomes will be seen in the individuals who have experienced the most adversity (i.e., a *stress sensitizing effect*; McLaughlin et al., 2010). However, the steeling effect differs from the cumulative risk model as it suggests that the best outcomes will be seen not in individuals with no experiences of adversity, but rather in those with a 'moderate' level of adversity (Liu, 2015). 'Moderate' adversity is proposed to be 'optimal' as the distressing event is perceived to be sufficiently challenging so that resilience resources can be successfully applied, practiced, and further improved. This in turn heightens the resistance to future adversity and protects well-being (Fergus & Zimmerman 2005; Rutter, 2012). Therefore, the steeling effect proposes a curvilinear, quadratic relationship between adversity and well-being outcomes, rather than the traditional negative linear dose-response relationship.

Empirical research on the 'optimal' level of adversity is an evolving field (for an overview see [blinded for review]). For instance, a study that investigated the steeling effect with 1164 adult participants found that a moderate amount of childhood risk factors, such as

physical punishment or parental illness, was associated with the lowest suicidality in adulthood (McLaffety et al., 2018). Another study on the steeling effect with 2398 adult participants showed that the highest level of life satisfaction and the lowest level of distress and functional impairment was found in participants who reported a moderate amount of lifetime adversities (Seery, Leo, Holman, & Silver, 2010). Additionally, a study with 91 adolescents found the lowest average cortisol activity and cortisol reactivity during a stress task in participants with a moderate amount of interparental conflicts experienced in childhood (Hagan, Roubinov, Purdom Marreiro, & Luecken, 2014). These studies provide first evidence for steeling as they demonstrate 'optimal' amounts of adversity which were associated with positive outcomes.

To investigate 'optimal' adversity, the above studies operationalized adversity as either the *number* of different adversities (McLafferty et al., 2018), or the *frequency* of each adversity (Hagan et al., 2014; Seery, Leo et al., 2010) (for more studies see [blinded for review]). While the operationalization of 'optimal' adversity as the amount (i.e., number/frequency of adversities) is a common approach in the steeling literature (see [blinded for review]), it neglects the subjective appraisal of the adversity by the individual. According to the *transactional stress model* (Lazarus & Folkman, 1984), the impact of the subjective appraisal of an adversity is crucial for understanding the heterogeneity in responses to adversity. A few studies exist that have examined the subjective appraisal of adversity with regard to the steeling effect. For instance, one study with 93 young adults showed the highest psychological growth at a moderate appraisal of dissociation during their most distressing life-event (McCaslin et al., 2009). Similarly, a study of 193 adult breast cancer survivors found the highest level of growth in participants with a moderate appraisal of general stress (Coroiu, Körner, Burke, Meterissian, & Sabiston, 2016). These findings provide preliminary evidence for the steeling effect and the role of subjective appraisal. However, some studies investigated curvilinear relationships between growth and the subjective appraisal of violent experiences, but with results showing

only positive linear relationships (Kleim & Ehlers, 2009; Kunst, 2010). Due to the inconsistent evidence, further research is needed to examine the role of subjective appraisal in the steeling effect. Furthermore, in order to establish an appropriate measure of adversity, research should investigate the amount of adversity, the subjective appraisal of the adversity, and their combined influence (i.e., as suggested in the *transactional stress model* and *cumulative risk model*) with regard to their roles in the steeling effect (Seery et al., 2010). However, no study currently exists in the steeling literature that has operationalized adversity as both the amount (number/frequency) and the subjective appraisal ([blinded for review]).

With regard to the mechanisms which underpin the steeling effect, the majority of the current knowledge is based on theoretical assumptions and models. Parallels have been drawn with the mechanisms underlying physiological immunization. When the immune system is confronted with an 'optimal' level of pathogens it should be able to draw on its resources in order to successfully manage these 'stressors'. This successful coping leads to an increased ability to cope with pathogens in the future to maintain health. Similarly, in relation to the steeling effect and psychological well-being outcomes, theoretical models on the mechanisms of steeling suggest that individuals utilize various resilience-related resources to successfully adapt to and cope with adversity, which in turn promotes resilience, and positively influences well-being outcomes (Liu, 2015; Rutter, 2012).

Previous research on adversity and resilience has identified some resources which may play an important role in the successful coping with adversity. These include *general self-efficacy*, which is the subjective evaluation of or belief in one's own ability to cope successfully with difficulties (Schwarzer & Luszczynska, 2007). *Self-compassion*, which influences the behaviors and thoughts directed at oneself in times of adversity (Neff, Kirkpatrick, & Rude, 2007). *Optimism*, which has been shown to influence the initiation and success of coping strategies (Nes & Segerstrom, 2006). Finally, *sense of coherence*, which is the ability to identify

and use internal and external resources to successfully manage stress (Antonovsky, 1987). While these resources have been shown to facilitate coping with adversity, they have not yet been examined within the context of (the underlying mechanisms of) steeling.

To address the gaps identified in the literature, the current study had three interrelated aims. The first aim was to examine whether steeling can occur within a one-year period in later life. The majority of previous studies on the steeling effect have applied a cross-sectional design ([blinded for review]), which can lead to the assessment of illusionary rather than genuine effects (Frazier et al., 2009). Therefore, the current study applied a longitudinal design. Furthermore, much of the previous research on the steeling effect and on resilience in general has been conducted with younger age groups ([blinded for review]; Masten, 2014). The current study therefore focused on older individuals. According to the successful aging literature, 'optimal' adversity in later life might more likely lead to a maintenance of resources on a function level (Baltes & Baltes, 1990; WHO, 2015) rather than to an improvement of resources (as would be expected by the 'classic' steeling effect). Hence, it was hypothesized that 'optimal' adversity helps to keep resources relatively stable. The second aim was to investigate the potential mechanisms underpinning the steeling effect by examining potential changes in the above-mentioned resources and satisfaction with life resulting from adversity. According to the *conservation of resources* theory (Hobfoll, 2001), resources that serve a common goal, such as coping, should all change in the same manner. It was therefore hypothesized that beneficial changes would equally occur in all resources in response to an 'optimal' level of adversity. Similarly, it was expected that low and high levels of adversity would lead to relatively poorer effects. The third aim was to investigate whether the operationalization of adversity as 'amount' (number and frequency), subjective appraisal, or their combined assessment, influenced the identification of a steeling effect. It was hypothesized that a steeling effect would only be detectable using the latter, more sensitive operationalization of adversity (Seery et al., 2010).

In order to investigate these research questions, a person-centered approach was applied, which provides insight into how variables within a coherent system act together (Zyphur, 2009). Such person-centered approaches use the heterogeneity in a given sample to identify homogeneous sub-groups which differ quantitatively and qualitatively across several group indicators. This method can therefore be applied to identify groups that show different changes in resources following stress or adversity.

Method

Study design and procedure

This study was part of a longitudinal, multi-method research project on the steeling effect ('Healthy Aging against the Odds – Mechanisms behind the Steeling Effect'; see also [blinded for review]). It was approved by the Swiss ethics committee of the Canton of Zurich (ID 2015-00135) and the Ethics Committee of the Faculty of Philosophy in the University of Zurich, Switzerland.

A longitudinal study was conducted in the German speaking parts of Switzerland, consisting of two measurement time points twelve months apart. The first assessment took place in summer 2016 (t_1) and the second in summer 2017 (t_2). Participants were recruited using flyers, advertisements in Swiss print-media and on websites directed at older adults, radio interviews with the study authors. Also, the participant pool of the University Research Priority Program 'Dynamics of Healthy Aging' of the University of Zurich was used for recruitment. Participants could complete a pen-and-paper survey or an online survey. For the pen-and-paper version, participants were posted a package containing information about the aims and procedure of the study, an informed consent form, and the survey. The online-survey was programmed using *unipark* software (Unipark, Germany) and participants received the same information and informed consent forms before they were able to begin the survey. At the

second assessment, participants received the questionnaire equally to the method chosen for the first assessment. As an incentive, after both assessments, participants who completed the survey were entered into a raffle for shopping vouchers.

Participants

Individuals had to be aged fifty years or older and native Swiss-German speaker. In order to detect at least medium effects with a statistical power of .80, using five profile indicators, a sample of about $N = 180$ participants was required (Dziak, Lanza, & Tan, 2014).

Measures

The following socio-demographic information was collected: age, gender, education, and relationship status.

Adversity experienced within the past year

At the second assessment, an adapted version of the *Social Readjustment Rating Scale-Revised* was applied (SRRS-R; Hobson et al., 1998). It assessed the number, frequency, and subjective appraisal of adversity experienced since the first assessment. Participants indicated (yes/no, this derives the number of experienced events) whether they had experienced any of 70 events (negative/adverse events such as: loss of a loved one, accident; and positive events such as new romantic partner, unexpected profit). As the SRRS-R mainly assesses common events over the lifespan, a literature review was conducted to include more age-specific adversities for later life. This resulted in an additional 19 events (e.g., loneliness, fear of health-related accidents). Additionally, the version used in the current study assessed the subjective appraisal of the stressfulness of an event using a range of 0 (no stress at all) to 100 (very stressful). Furthermore, the adapted scale assessed the frequency of each event, i.e., how many times each event was experienced (1 = once, 2 = twice, 3 = three times, 4 = four times, 5 = five or more times, 6 = a permanent or frequently re-occurring event).

Based on this instrument, the following four indicators were derived: (1) the total number of adverse events, (2) the sum of the frequencies for all events, (3) the average subjective appraisal of adverse events, and (4) an index of adversity. The index of adversity was an indicator for the overall stressfulness of the past year. It was derived by first multiplying the frequency and stressfulness for each experienced adversity and then calculating the mean of the resulting score for all individually experienced adversities.

Resources: Profile indicators

Resilience was measured using the short version of the *Resilience Scale* (RS; Schumacher, Leppert, Gunzelmann, Strauss, & Brähler, 2004). The scale consists of eleven items rated on a seven-point Likert scale and load onto one factor (*Cronbach's α* = .91).

General self-efficacy was measured using the *Generalized Self-Efficacy Scale* (GSES), which consists of ten items rated on a four-point Likert scale (Schwarzer & Jerusalem, 1999) and load on one factor (*Cronbach's α* = .82) (Scholz, Doña, Sud, & Schwarzer, 2002).

Self-compassion was assessed using the short form of the *Self-Compassion Scale* (SCS), which consists of twelve items rated on a five-point Likert scale (Raes, Pommier, Neff, & Gucht, 2011). It is composed of six factors (self-kindness, self-judgement, common-humanity, isolation, mindfulness, over-identification) that load onto one higher-order factor of *self-compassion* (*Cronbach's α* = .87), which was used for the analyses.

Optimism was measured using the *Life Orientation Test Revised*, which assesses optimism and pessimism on separate subscales (LOT-R, Scheier, Carver, & Bridges, 1994; Glaesmer, Hoyer, Klotsche, & Herzberg, 2008). These subscales load onto one higher-order factor of *optimism* (*Cronbach's α* = .59). The scale consists of ten items rated on a five-point Likert scale.

Sense of Coherence was assessed using the *Sense of Coherence - Revised Scale* (SOC-R), which consists of 13 items rated on a five-point Likert scale (Bachem & Maercker, 2016).

It is composed of three factors: manageability, reflection, and balance; which load onto one higher-order factor of sense of coherence (*Cronbach's α* = .78) (Mc Gee, Höltge, Maercker, & Thoma, 2017).

Outcome: Satisfaction with Life

Global life satisfaction is an important part of subjective well-being and was assessed in the current study using the *Satisfaction with Life Scale* (Diener, Emmons, Larsen, & Griffin, 1985). It consists of five items rated on a seven-point Likert scale (*Cronbach's α* = .92; Glaesmer, Grande, Braehler, & Roth, 2011).

Data Analysis

Latent Profile Analysis

Latent profile analysis (LPA) was conducted to identify latent profiles of change based on the above described five resources. This method detects unobserved heterogeneity within a population on the basis of manifest variables (Kretschmer, Barker, & Dijkstra, 2015; Muthén & Muthén, 2015).

LPA was conducted using M*plus* version 8.0 (Muthén & Muthén, 2017). LPA is an inductive, iterative analysis process using full information maximum likelihood estimation. To prevent a local maximum, 500 starting value sets were used in the first step of the optimization process, with the 50 starting value sets which showed the largest log likelihood values in the first step being used in the second step (Geiser, 2013). Furthermore, 50 iterations were used at the beginning of the optimization process (Geiser, 2013; Uebersax, 2000).

In order to identify the best-fitting model, statistical indicators and substantive theory were consulted (Nylund, Bellmore, Nishina, & Graham, 2007). Statistical indicators of relative model fit included the bootstrap log-likelihood ratio difference test (BLRT) and the Vuong-Lo–Mendell–Rubin adjusted likelihood ratio test (VLMR; Geiser, 2013). A significant result on

these tests indicates that a model with k-profiles is a better fit for the data in comparison to a model with k-1 profiles. Furthermore, model fit was also assessed using information criteria (IC), such as Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and sample-size adjusted Bayesian Information Criterion (SSA-BIC) as well as the entropy of a model, and the log-likelihood (LL). Lower values for the IC and high entropy of a model (≥.8) indicate better model fit. Nylund, Asparouhov and Muthén (2007) recommend focusing on the BLRT and BIC as the basis for the statistical decision about the adequate number of profiles. Furthermore, to be considered a profile, each group should consist of at least 5% of the total sample (Kretschmer et al., 2014).

To compare the profiles with regard to the adversity experienced within the past year and the change in satisfaction with life, the modified *Bolck-Croon-Hagenaars* procedure (BCH) procedure was implemented through M*plus* (Asparouhov & Muthén, 2015; Vermunt, 2010). This method is considered to be superior to other similar procedures as it uses robust standard errors and takes the classification error of profile membership into account by using weighted group analysis (Bakk & Vermunt, 2016). In order to identify significant mean differences between the profiles, multivariate Wald χ^2-tests are used (Bakk & Vermunt, 2016).

In order to examine the impact of socio-demographic covariates on profile membership, the R3STEP procedure was used (Asparouhov & Muthen, 2015). This method uses multinomial logistic regressions and also takes the classification error into account (Vermunt, 2010).

Results

Sample characteristics

Of the 260 participants who completed both assessments, 58 were excluded from the analyses due to missing data on the frequency and stressfulness of their events. A further *n* =

15 was removed due to outliers (values below or above 1.5x interquartile range) in the main study variable of subjective appraisal of stressfulness.

The final sample consisted of 187 participants, 131 (70.1%) were female and 56 (29.9%) were male. The mean age of the sample was 67.32 years (*SD* = 8.54, range = 50-88 years). Regarding relationship status, 84 (44.9%) participants were in a relationship and 103 (55.1%) were single. Regarding employment status, 58 (31.7%) participants were employed, 103 (55%) were unemployed/retired, and 22 (11.8%) were involved in voluntary activities. The online survey was completed by 159 participants (85%, M_{age} = 66.18) and the pen-and-paper version was completed by 28 participants (15%, M_{age} = 73.75). The majority of participants indicated vocational training (31%) as their highest level of education, followed by university (20.3%), university of applied sciences (17.1%), specialized vocational training (13.4%), other (8%), secondary/high school (8.5%), and primary school (1.6%).

Participants reported an average number of 2.67 different adverse events during that time (range = 0-12 adverse events), an average frequency of 8.64 adverse events (range = 0-62 adverse events), an average subjective appraisal of 103.29 (range = 0-370), and an index of adversity of 380.64 (range = 0-1580) during the past year.

Based on the mean differences in the profile indicators (resilience, general self-efficacy, self-compassion, optimism, sense of coherence) and the outcome (satisfaction with life), no significant differences were shown between t_1 and t_2 (see Table 2). Nevertheless, a large variance was observed for each variable, indicating the appropriateness of a person-centered approach.

Latent profiles of change

Models with up to five profiles were analyzed (see online supplement for model fit indices). The model with three profiles was chosen for a number of reasons. First, it showed the lowest BIC, with the BLRT indicating that the four-profile solution did not lead to a significant

improvement of model fit. Second, this model showed a sufficient entropy above .8. Third, this model resulted in adequate group sizes for each profile (i.e., more than 5% of the sample). Fourth, this model resulted in profiles with substantive meaning in order to test the steeling effect theory (see next section).

Table 2. Means, standard-deviations, reliability, and correlations of the main study variables.

	M(*SD*)	α_{t1}	α_{t2}	r_{t1t2}	1	2	3	4	5	6	7	8	9	10
1 Number of adverse events	2.67 (2.16)	-	-	-	-	.83**	.67**	.6**	.07	.05	-.02	.04	.08	-.13
2 Frequency of adverse events	8.64 (8.4)	-	-	-		-	.62**	.74**	.11	.08	.04	.13	.12	-.1
3 Subjective appraisal of adverse events	103.29 (89.14)	-	-	-			-	.88**	.05	.00	-.01	-.03	.08	-.03
4 Index of adversity	380.64 (383.62)	-	-	-				-	.07	-.01	.02	.05	.14	-.02
5 Δ Self-efficacy	0.03 (3.4)	.86	.86	.61**					-	.26**	.26**	.14	.33**	.26**
6 Δ Self-compassion	1.07 (4.99)	.8	.78	.72**						-	.13	.12	.25**	.08
7 Δ Optimism	0.2 (2.79)	.69	.69	.7**							-	.01	.22**	.21**
8 Δ Sense of Coherence	-0.14 (4.69)	.75	.79	.65**								-	.12	.12
9 Δ Resilience	-1.52 (6.64)	.82	.85	.69**									-	.26**
10 Δ Satisfaction with life	-.19 (4.27)	.85	.86	.72**										-

Note: Δ = difference in variable between assessment 1 and 2 (positive difference = increase, negative difference = decrease), α = *Cronbach's α* (reliability) at the first and second assessment, r_{t1t2} = re-test reliability.

* $p < .05$, ** $p < .01$

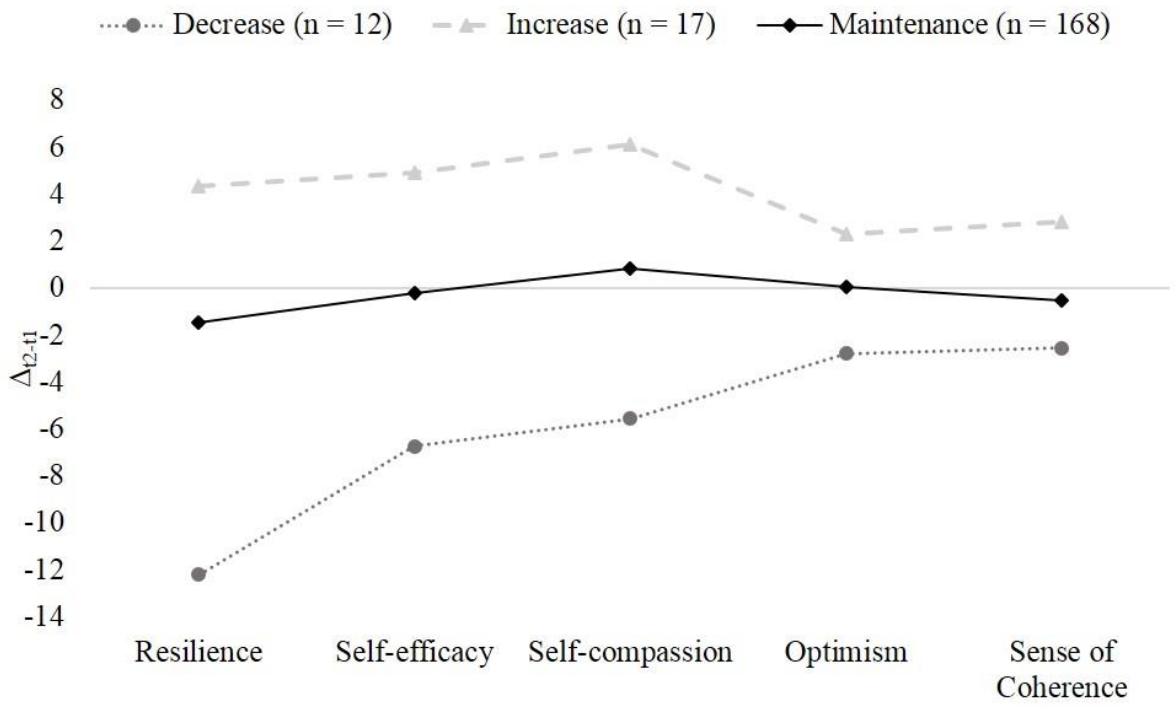
Table 3 and Figure 4 show the characteristics of the resulting three profiles. Profile 1, termed 'Decrease', is the smallest group, consisting of 6.1% of the study sample (n = 12) and is characterized by an overall decrease in the resources. Profile 2, termed 'Increase', consists of 8.6% of the study sample (n = 17) and is characterized by an overall increase in the resources. Profile 3, termed 'Maintenance', is the largest group, consisting of 85.3% of the study sample (n = 168) and is characterized by an overall relative stability of resources.

Table 3. Means of the indicators for each latent profile.

	Decrease (n = 12)	Increase (n = 17)	Maintenance (n = 168)
Δ Resilience	-12.21	4.35	-1.49
Δ Self-efficacy	-6.75	4.92	-.24
Δ Self-compassion	-5.65	6.12	.85
Δ Optimism	-2.8	2.29	.04
Δ Sense of Coherence	-2.56	2.81	-.53

Note: Δ = mean difference in variable between assessment 1 and 2 (positive difference = increase, negative difference = decrease).

Figure 3. Mean change in the indicators between the first (t_1) and second (t_2) assessment for each resulting latent profile.



Note: Negative/positive values indicate a decrease/increase in the respective indicator; *n* = number of group members.

Differences in experienced adversity and change in satisfaction with life between the profiles

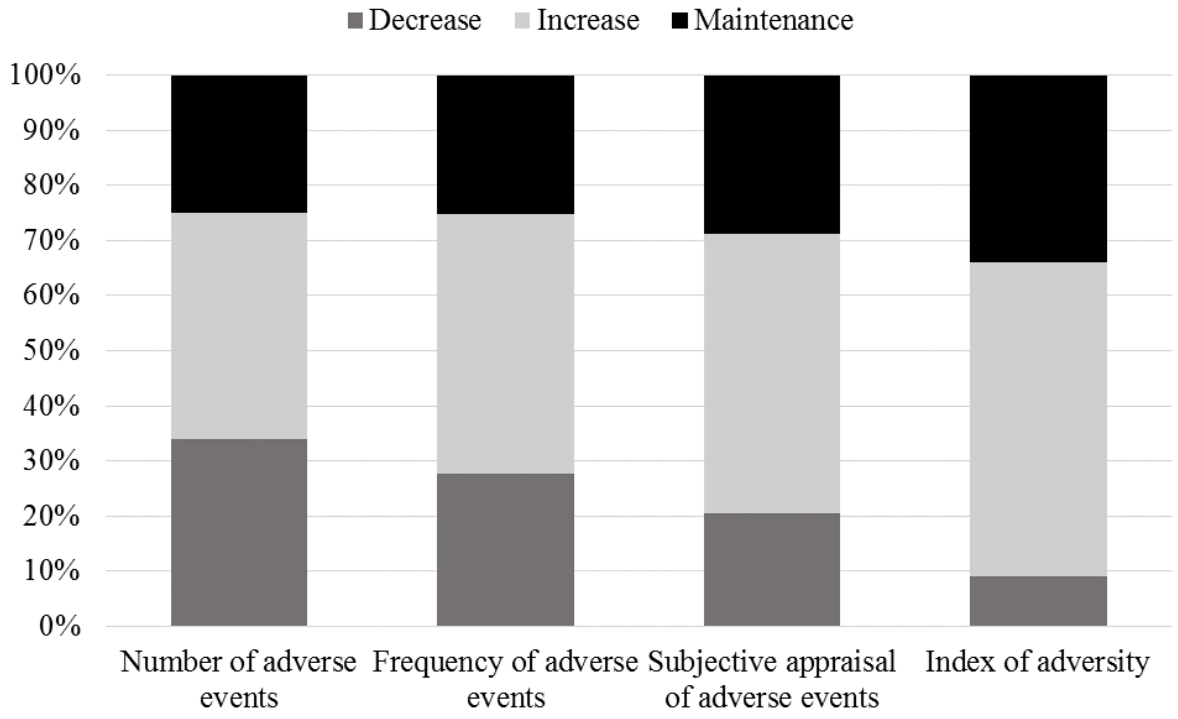
The modified BCH method was used to examine whether there were any differences in the adversity indicators and the change in satisfaction with life. The 'Increase' profile showed the highest values across all adversity indicators (see Table 4 and Figure 5). The 'Decrease' profile showed the lowest values in the adversity indicators: subjective appraisal of the stressfulness of the adverse events and the index of adversity. The 'Maintenance' profile showed the lowest values for the number and frequency of adverse events.

Table 4. Differences between the profiles based on the indicators: adversity in past year and the change in satisfaction with life.

	Decrease (A)	Increase (B)	Maintenance (C)	χ^2 overall	*p*
	M (*SE*)	*M* (*SE*)	*M* (*SE*)		
Number of adverse events	3.91 (1.41)	4.71 (1.01)	2.875 (2.86)	5.67	.06
Frequency of adverse events	10.06 (5.45)	17.16 (4.34)	9.151 (.77)	3.18	.2
Subjective appraisal of adverse events	69.64 (37.66)^{B}	171.78 (36.14)^{A}	97.62 (7.21)	4.57	.1
Index of adversity	98.35 (59.83)^{B,C}	620.702 (117.01)^{A,C}	369.42 (32.68)^{A,B}	22.8	< .001
Δ Satisfaction with life	-3.6 (1.73)^{B}	2.12 (1.32)^{A}	-.02 (.035)	7.00	.03

Note: *M* = mean. *SE* = standard-error; Δ = mean difference in variable between the first (t_1) and second (t_2) assessments (positive difference = increase, negative difference = decrease); The *df* of the overall χ^2-tests is 2; Superscripts (A, B, C) indicate which profiles differ significantly at $p < .05$ for that respective variable.

Figure 4. Distribution of the resulting latent profiles on each adversity measure.



Significant differences were found for the average subjective appraisal of adverse events between the 'Decrease' and 'Increase' profiles ($\chi^2(2) = 3.87$, $p = .049$), with the 'Decrease' profile ($M = 69.64$) showing significantly less subjective stress than the 'Increase' profile ($M = 171.78$). Furthermore, significant differences were found for the index of adversity between all profiles: 'Maintenance' and 'Decrease' ($\chi^2(2) = 14.12$, $p < .001$), 'Maintenance' and 'Increase' ($\chi^2(2) = 3.92$, $p = .048$), and 'Decrease' and 'Increase' ($\chi^2(2) = 16.05$, $p < .001$), with 'Decrease' showing the lowest level ($M = 98.35$), 'Maintenance' showing a moderate level ($M = 369.42$), and 'Increase' showing the highest level of experienced adversity ($M = 620.70$).

'Decrease' and 'Increase' differed significantly in the change in satisfaction with life ($\chi^2(2) = 6.97$, $p = .008$; see Table 3), with 'Increase' showing a positive change ($M_{change} = 2.12$) and 'Decrease' showing a negative change ($M_{change} = -3.6$).

Covariates of profile membership

The influence of the sociodemographic variables on profile membership was examined using the R3STEP method (see Table 5). Results indicate a significant impact of age, i.e., younger participants were more likely to belong to 'Increase' and older participants to 'Maintenance' (*OR* = .18, *p* = .01, 95% *CI* [.12, .25]).

Table 5. Odds ratios [95% CIs] for the relationship between covariates and latent profile membership.

	Decrease vs. Increase	Maintenance vs. Increase	Decrease vs. Maintenance
Gender	.31 [-.78; 1.4]	.74 [-.18; 1.66]	.43 [-.44; 1.3]
Age	.13 [.05; .21]	.18 [.12; .25]*	.05 [0; .1]
Relationship status	1.2 [.05; 2.35]	1.71 [.75; 2.67]	.51 [-.31; 1.33]
Education	.16 [-.04; .36]	.08 [-.07; .23]	-.08 [-.25; .09]

Note: CI = confidence interval, positive odds ratio = higher values on the covariate indicate that a participant is more likely to be in the first profile listed, negative odds ratio = higher values on the covariate indicate that a participant is more likely to be in the second profile listed.

* $p < .05$

Discussion

The study investigated the function of an 'optimal' level of adversity for resilience and well-being in later life and examined potential underlying mechanisms of the steeling effect. More specifically, it examined whether steeling can occur within a one-year period. It further investigated whether the operationalization of adversity influenced the identification of a steeling effect. A longitudinal survey study with two measurement time points was conducted to assess the experienced adversity, and the change in psychological resilience resources and satisfaction with life (SWL). Latent profile analysis was chosen to identify profiles which showed changes in these variables following adversity. Three profiles were identified: an overall decrease in resources ('Decrease'), an overall increase in resources ('Increase'), and

relative stability of resources ('Maintenance'). In line with the steeling effect, results indicated that the 'Decrease' profile showed the lowest level of adversity. However, in contrast to the 'classic' steeling effect, the 'Maintenance' profile showed a moderate level and the 'Increase' profile showed the highest level of adversity. Furthermore, the 'Decrease' and 'Increase' profiles differed significantly regarding SWL, with the 'Decrease' profile showing decreased and the 'Increase' profile showing increased SWL. Meaningful differences between the profiles were detected only by the more sensitive measure of adversity.

In relation to the first aim of the study (i.e., the function of 'optimal' adversity in later life), results only partially supported the steeling effect (Liu, 2015). According to this theory, the 'Increase' profile should have been characterized by a moderate level of adversity, while the other two profiles should have been characterized by lower or higher levels of adversity. However, the 'Increase' profile showed the highest level of adversity, with the 'Decrease' and 'Maintenance' profiles showing the lowest and moderate levels of adversity, respectively. These findings on low adversity and the related decrease in resources partly support the steeling effect. As was demonstrated in the current study, the steeling effect suggests that very low levels of adversity can actually have a negative impact on coping abilities, by heightening vulnerability to future adversity and in turn, diminishing well-being (Liu, 2015; Seery, 2011).

The 'Maintenance' profile, which contained the most participants, showed a moderate level of adversity. This finding supports neither the steeling effect theory, which would predict an increase in resources rather than stability, nor the more traditional stress-response models, which would expect increasing negative effects in line with an increasing level of adversity (McLaughlin et al., 2010; Sameroff, 2000). However, given that the participants in this profile were older relative to the 'Increase' profile, this result can be interpreted from a successful aging perspective (Baltes & Baltes, 1990; WHO, 2015). Successful aging suggests that in light of age-related decreases in resources, older individuals select and utilize resources in order to fulfill central life goals and to maintain a functional level of well-being. Therefore, these results

may add to the existing literature on successful aging and the steeling effect ([blinded for review]) by showing that 'optimal' adversity in older individuals may support the maintenance of existing resources, rather than increase resources according to the classical view of steeling. Therefore, future research is required to further explore age-specific steeling effects.

An unexpected finding, which contradicts the steeling effect and the cumulative risk model (Sameroff, 2000), was that the 'Increase' profile showed the highest level of adversity. One explanation may be related to the research finding that older adults tend to report a high quality of life despite having experienced multiple or even severe adversities, which can be regarded as an indicator of a pronounced resilience (Netuveli & Blane, 2008). Additionally, research has shown that such pronounced resilience can result in a decreased possibility for positive effects in response to adverse experiences (Levine, Laufer, Stein, Hamama-Raz, & Solomon, 2009). This may indicate that older adults with pronounced resilience may 'require' a higher level of adversity in order to initiate steeling processes.

Another possible explanation may be provided by the concept of *posttraumatic growth* (PTG), which refers to an increase in resilience due to severe adversity (Tedeschi & Moore, 2016). This has been shown in adults following the experience of adversities such as cancer (Cordova, Cunningham, Carlson, & Andrykowski, 2001). Thus, the current findings of increased resilience resources resulting from a high level of adversity may be evidence of PTG. Related to post-traumatic growth, is the potential influence of 'illusionary growth' (Zoellner & Maercker, 2006). It suggests that acute coping strategies, in form of illusionary self-enhancing cognitions, are often used to reduce acute distress in reaction to severe adversity. Therefore, the one-year period in the current study may have been too short a time frame, resulting in the capture of 'illusionary growth' in the 'Increase' group, rather than genuine increases. Future studies should therefore examine these effects over a longer time period in later life.

In relation to the second aim of this study, our results reflect a potential underlying mechanism for the potential positive effects of adversity on well-being outcomes as suggested

by the steeling effect. The SWL of our participants changed in the same direction as the resources of the respective profiles. Therefore, the experience of moderate adversity probably helps to maintain central resources for coping with adversity at a functional level. In turn, people maintain their level of SWL, because they can cope with potential obstacles of what they value in life (Baltes & Baltes, 1990). Also, while it has been shown that SWL can positively change due to a high pre-crisis resilience in response to a crisis (Fredrickson, Tugade, Waugh, & Larkin, 2003), our results could show a potential further mechanism. SWL could also increase, because people become more confident and competent in dealing with future adversities because of the experience of adversity.

With regard to the third aim of the study, results support the use of a more sensitive measure of adversity (Seery et al., 2010): combining the amount (defined as the number of different adversities experienced and the frequency of each adversity; Sameroff, 2000) and the subjective appraisal of each adversity (Lazarus & Folkman, 1984). Meaningful differences between all three profiles were detected only by the more sensitive measure of adversity. Neither the number nor the frequency of adverse experiences alone identified any significant differences. While previous studies have shown a steeling effect using these operationalizations (e.g. Seery, 2011), the non-significant results in the current study may be due to the age of the sample or the time frame. The short time frame may not have been sufficient to identify such a sufficient amount of adversities. Related to this, as older age may be associated with a higher psychological resilience (Levine et al., 2009), the amount of adversities during this time frame may not have been sufficient enough for the detection of inter-individual differences.

Strengths

Given the global rapid increase in the number and percentage of older individuals (WHO, 2015), a better understanding of the dynamics of resilience in later life is of utmost importance. In a research field that is traditionally focused on early life (Masten, 2014), the focus on resilience in older adults is therefore a particular strength of the current study.

Furthermore, this study was the first to examine the steeling effect using a person centered approach and longitudinal design. Past research has shown that in order to find genuine effects of adverse experiences, a longitudinal design is required with pre- and post-assessments of the same variables (Frazier et al., 2009).

Limitations and future research

A somewhat more complex operationalization of adversity was used in comparison to former studies on steeling by combining objective (amount) and subjective (appraisal) indicators. However, future studies should also consider examining other stress indicators. For example, the centrality of an event for an individual should be assessed, as it may influence the subjective appraisal of an adverse event, as well as the individual's motivation to deal with the adversity (Hobfoll, 2001; Lazarus & Folkman, 1984). In addition, as was recently conducted in a study of resilience in cancer patients (Dooley, Slavich, Moreno, & Bower, 2017), future studies could differentiate between acute and chronic adversities.

A further recommendation would be to use additional resources as profile indicators, as the current study focused solely on internal psychological resilience resources. Resilience is a multi-systemic construct (Masten, 2014), and therefore biopsychosocial and ecological indicators should be considered in future studies (Ungar, 2012).

Related to the sample, while analysis methods were used that were robust to group size and each profile contains more than the required amount (i.e., 5%), future studies should use a larger overall sample size to achieve greater variability within the sample to increase the number of participants in each profile, and improve generalizability of results.

Additional sample limitations relate to the socio-demographic characteristics. The current study had a higher percentage of female participants, highly educated participants, as well as a lack of cultural variation. In addition, there was a high percentage of online-survey users. As research has shown that older adults who are internet users show higher positive well-being (Chen & Persson, 2002), this may have impacted the sample. Participants also self-

selected into the study and were aware of the aims before taking part. Therefore, a selection effect may also have influenced sample composition.

Conclusion

Traditionally, any level of adversity is viewed as pathological and the more severe an adversity is, the worse are the expected outcomes. The findings of this study contradict this traditional perspective, as the lowest level of adversity was associated with the worst outcomes. Furthermore, a moderate level of adversity was associated with the maintenance of resources, which is crucial in later life for successful aging. The highest level of adversity was associated with increased resilience resources and satisfaction with life, which may indicate increased resistance in older adults as a result of life experiences. In conclusion, while this study does not undermine the negative effects of adversity, it suggests that under certain circumstances some adversity may help individuals to maintain their well-being and may even foster thriving.

Online Supplement: Table 6. Model fit indices of the latent profile analysis.

Number of profiles	FP	LL	AIC	BIC	SSA-BIC	Entropy	BLRT	VLMR
One	10	-2797.49	5614.98	5647.82	5616.137	-	-	-
Two	16	-2770.19	5572.373	5624.91	5574.22	.83	-2797.49***	-2797.49
Three	22	-2752.99	5549.98	5622.21	5552.52	.85	-2770.19***	-2770.19
Four	28	-2745.2	5546.4	5638.33	5549.62	.88	-2752.99	-2752.99
Five	34	-2737.25	5542.49	5654.12	5546.41	.89	-2745.2	-2745.2

Note: FP = Free Parameters; LL = Log-Likelihood; AIC = Akaike Information Criteria; BIC = Bayesian Information Criteria; SSA–BIC = sample-size adjusted BIC; BLRT = Bootstrapped Log-Likelihood Ratio Test; VLMR = Vuong-Lo-Mendell-Rubin Test.

* $p < .05$, ** $p < .01$, *** $p < .001$

8.1.3 Manuscript 3: Childhood adversities and thriving skills: The sample case of older Swiss former indentured child laborers

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Abstract

Objective The study of life-long consequences of severe childhood adversities or trauma has recently received much attention. However, little is known about the subjective coping success and development of positively-evaluated resources, which may originate within these adverse experiences, and which may be conceptualized as thriving. This study set out to examine the relationship between thriving in response to early adversity and successful aging with a sample of former indentured child laborers in Switzerland (*Verdingkinder).*

Method Participants were screened according to subjective and objective health-related attributes and those who were evaluated to be 'successful agers' were included. Semi-structured interviews were conducted with twelve former Verdingkinder, mean age: 71 years, that lasted 60 – 120 minutes. The interviews were analyzed using the paradigm model of the Grounded Theory.

Results In the interviews, a variety of adverse experiences and negative consequences were reported. However, where thriving was triggered in response to these experiences, the factors identified as 'lightheartedness', 'social purpose', and 'self-enhancement' were associated with successful aging. Factors including motivation, reflection, personality traits, social support, individual coping strategies, turning points, and processing were reported as central to thriving.

Conclusion The identified factors show similarities with established predictors of health and well-being. Thus, we conclude that under certain circumstances early and prolonged adverse experiences can also provide the opportunity to develop positive resources for successful aging.

***Keywords*:** adverse childhood experiences; thriving; posttraumatic growth; successful aging; qualitative study

Objective

Advancing age is still predominantly associated with declining functional abilities and health especially in individuals that experienced extended life strains.[1] However, research on 'successful aging' is dedicated to understand the potential pathways to good health in older adulthood. The most widely applied definition is the one proposed by Rowe and Kahn, which defines successful aging as a multidimensional construct encompassing "…low probability of disease and disease-related disability (including risk-factors for disease), high cognitive and physical functional capacity, and active engagement with life (especially social and productive activity)" (p. 433) in old age.[2]

The scientific study of any form of successful aging is particularly rare with high-risk groups such as individuals with severe childhood adversities, due to the traditional pathogeneic view of such experiences. Experiences of early-life adversity have often been found to lead to mental disorders[3] or accelerated biological aging.[4]

However, recent research suggests that adversity can, under certain circumstances, also facilitate successful aging by increasing resilience and adaptability.[5,6] Three established theories on the positive outcomes of adversity are 'resilience'[5], 'thriving'[7], and 'posttraumatic growth'[8]. Resilience is the dynamic and context-sensitive ability to immediately resist adversity and quickly recover, which is dependent on an individual's adaptability.[5,9] Therefore, adaptability in the context of resilience is aimed at maintaining or regaining homeostasis. Adaptability in the context of thriving and posttraumatic growth refers to lasting adaptations and changes triggered by an adversity that in turn leads to an increased resilience towards future adversities.[7,8,10] However, there is a lack of research on the potentially positive long-term effects of early-life adversity and whether they influence health and well-being in old age.

One recent study showed that early-life adversity can increase social support in midlife, which in turn is positively associated with life satisfaction, positive affect, and social relations in old age.[11] Furthermore, Liu proposed a model of resilience in which early-life stressors could

lead to positive development through resilience factors which act as moderating factors on the relationship between adversity and well-being.[12] The identification and promotion of such factors is of utmost importance for maintaining good health and well-being throughout the lifespan.

A qualitative approach could provide a better understanding of the relationship between positive outcomes of early-life adversity and successful aging in older adulthood. First, the explorative nature and inductive approach provides the possibility to gather in-depth information.[13] Second, recent research has identified the need to explore person- and event-specific manifestations and trajectories, which is served by an open-interview format.[14,15]

To generate an initial model of thriving and successful aging based on adverse childhood experiences a homogenous group of 'experts' was required who had experienced severe early-life adversity and yet still could be considered as 'successful agers'. The Swiss subpopulation of former *Verdingkinder* provide a unique sample in which to investigate this relationship. Verdingkinder, refers to Swiss former indentured child laborers, are known for their adverse living conditions in early-life such as forced separation from family of origin and living with a foster family, denial of food or education, and maltreamtent (please see the online supplemental material for a description of Verdingkinder).[16,17]

However, many former Verdingkinder, who have now reached old age, do not fulfill criteria for a clinically relevant mental disorder and show signs of a pronounced resilience.[17,18] Therefore, further in-depth research with this specific sample provides a unique opportunity to study the potential relationship between long-term positive outcomes of early-life adversity and successful aging. On the basis of 'expert' interviews with successfully aging former Verdingkinder, the current study aimed to develop an initial model of the relationship between thriving (as triggered by indentured childhood labor) and successful aging that incorporates factors and underlying mechanisms involved in this positive development.

Method

The study was approved by the Ethics Committee of Zurich (protocol number: 2015-00135), and the Ethics Committee of the Faculty of Philosophy of the University of Zurich, Switzerland.

Participation criteria

Potential participants had to fulfill the following criteria: aged 50 years or older, fluent in (Swiss-) German, having lived as a Verdingkind for at least one year, as well as high current subjective and objective health, intact functionality and social activity in accordance with the successful aging definition by Rowe and Kahn.[2] To determine successful aging, potential participants were asked how they rate their health in general, if they have a chronic illness, if they feel limited in daily activities or personally-important activities due to health issues, if they accessed professional help due to psychological problems during the past twelve months, how satisfied they were with their current social network and life situation, and how they have generally felt during the past month (e.g., depressive, happy, balanced/calm, abject). According to the original definition of successful aging[2], participants would be required to have no limitations and show high levels of satisfaction. However, critiques of this definition suggest it is too restrictive and focuses on perfect health[19]. Therefore, in the current study the definition was adapted slightly so that the following criteria was considered to still be 'successfully aging': general health rated as good to very good, have one chronic illness, rarely to never feel depressed or abject, often to always feel happy or balanced/calm, and being satisfied to very satisfied with their social network and life situation. The successful aging definition also set the exclusion criteria and led to the exclusion of former Verdingkinder who did not fulfill these criteria, i.e., those who could not be characterized as successful aging.

Procedure

Recruitment: Flyers were distributed at various former Verdingkinder networks, churches, shopping centers, and retirement homes, and announcements were made in the media. Also, former Verdingkinder who had spoken about their experiences in public or print publications were directly approached. The Federal Office of Justice of Switzerland was also contacted, as it is in charge of all current legal matters relating to Verdingkinder.

Interviews: The interviews were audiotaped and were conducted by the first author as well as two master students. They were trained by the last author who is a trained psychotherapist. Semi-structured interviews were conducted since they are particularly useful in the reconstruction of subjective theories.[13] The previously-defined, broad questions facilitate the assessment of theoretically relevant aspects while allowing for the exploration of patterns and new facts.[20]

Twelve interviews were conducted as past research indicates that this number can be sufficient in order to achieve theoretical saturation when purposive sampling is used.[21] The interviews lasted 60–120 minutes and consisted of questions grouped according to the following structure: (1) the significance of the *Verdingung* (indentured childhood labor) for the person's development, (2) life before the Verdingung, (3) life during the Verdingung, (4) coping with adverse experiences during the Verdingung and the development of resources, and (5) life after the Verdingung and the subsequent handling of its experiences. Following the interview, participants completed a questionnaire on socio-demographics and facts about their time as a Verdingkind (see sample characteristics of the results). Participants were debriefed on potential emotional reactions after the interviews and provided with information sheets containing addresses for psychological support.

Data analysis

Transcription and analysis was conducted using *MAXQDA 12.2.1 software* (VERBI GmbH). Independent parallel coding (IPC) was used for coding consistency.[22] Independent

parallel coding (IPC) was used for coding consistency. Each interview was analyzed by two persons, with all interviews analyzed by the first author. The assistants were trained in the analysis method by the first author. After the final codebook was derived through IPC, all interviews were coded again, showing an inter-rater relability of $\kappa = .87$.

Semi-structured interviews have been used in previous studies to investigate thriving, using the data-analysis procedure of Grounded Theory.[15] The Grounded Theory method was developed to address the frequently-found gap between logically-derived theories and reality, by facilitating the exploration and systemization of the subjective theories of participants who share a common experience.[23] This method was also chosen due to its usefulness in exploring processes of change and development.[23] In the current study this refers to positive changes following adverse experiences. The Grounded Theory data-analysis procedure outlined by Strauss and Corbin was followed and involved three steps: open coding, axial coding, and selective coding.[24] First, in open coding, in-vivo codes were inductively-derived in order to create a category system. Second, in axial coding, a coding system was developed to identify causal relationships and connections between the resulting categories. This step was guided by the paradigm model that provides guidelines to depict the causal structure of conditions between experiences and their outcomes. The paradigm model assigns the empirically derived sub-categories into "…causal conditions, phenomenon, context, intervening conditions, action/interactional strategies, and consequences".[24] Third, in selective coding, the core category was identified.

Results

Sample Characteristics

Participants were twelve former Verdingkinder (M_{age} = 71; age range = 59–88 years; 50% female). Please see TABLE 7 for socio-demographic characteristics.

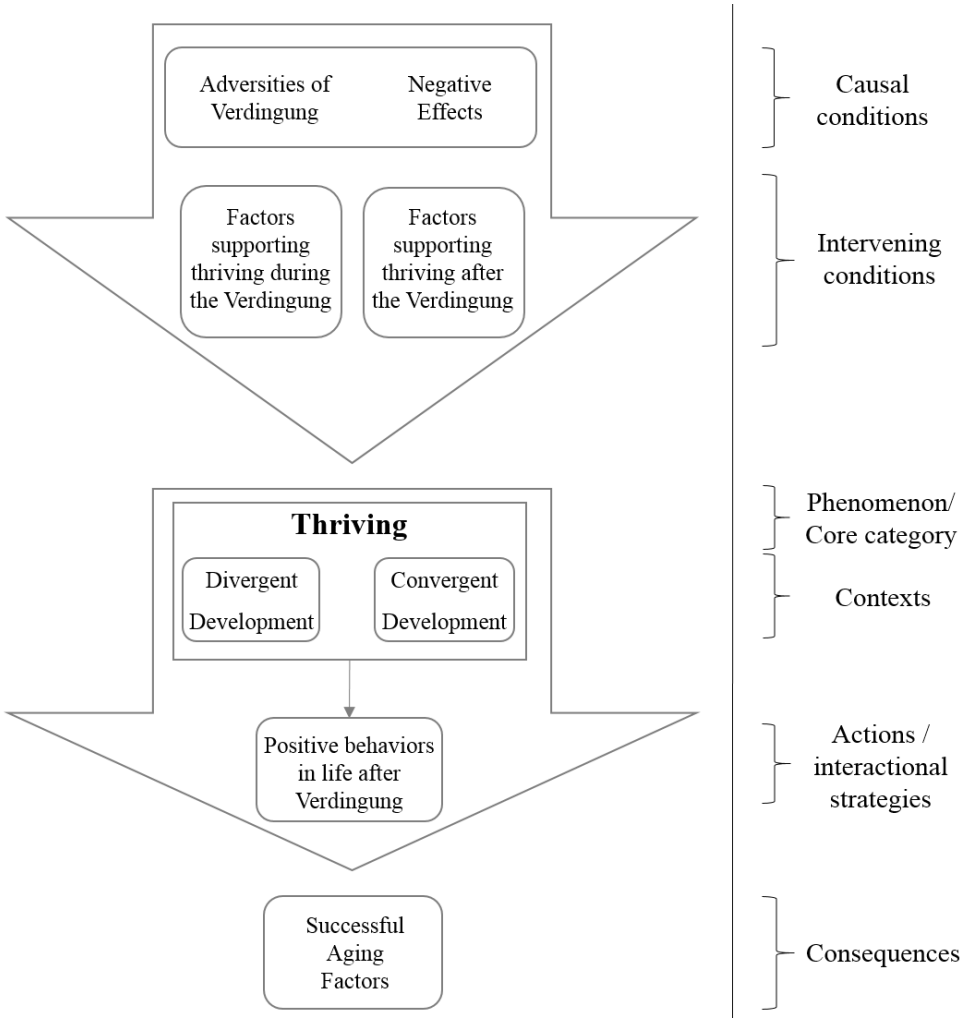
Table 7. Sample characteristics.

Person	Age	Gender	Years of indentured childhood-laboring	Age at the start of the Verdingung	Age at the end of the Verdingung	Number of foster families	Employment status	Relationship status
1	84	Male	13	3	16	6	Retired	Married
2	62	Male	9	7	16	6	Employed	Partnership
3	63	Male	7	8	15	2	Retired	Single
4	80	Female	12	2	14	1	Retired	Married
5	74	Male	1	11	12	2	Retired	Married
6	-	Female	1	6	7	3	Retired	Single
7	70	Female	-	-	14	3	Retired	Married
8	72	Female	-	-	20	2	Retired	Married
9	64	Female	7	8	15	3	Retired	Partnership
10	66	Male	2	13	15	6	Retired	Single
11	88	Male	5	9	14	6	Retired	Single
12	59	Female	9	7	16	6	Employed	Married

A model of thriving following early-life adverse experiences and successful aging

The following sections explain in detail the categories which were derived according to the paradigm model. Please see the online supplementary material for excerpts of the translated and the original Swiss German quotes. Subscript letters attached to the name of a category refer to the corresponding quotes in the online supplementary material. FIGURE 6 provides an overview of the structure of the resulted model (see FIGURE 6).

Figure 6. The structure and relationships between the core phenomenon of thriving and the main categories according to the paradigm model. Interplay between the causal and intervening conditions leads to thriving. Thriving is characterized by divergent and convergent development which elicits certain positive behaviors and lead to successful aging.



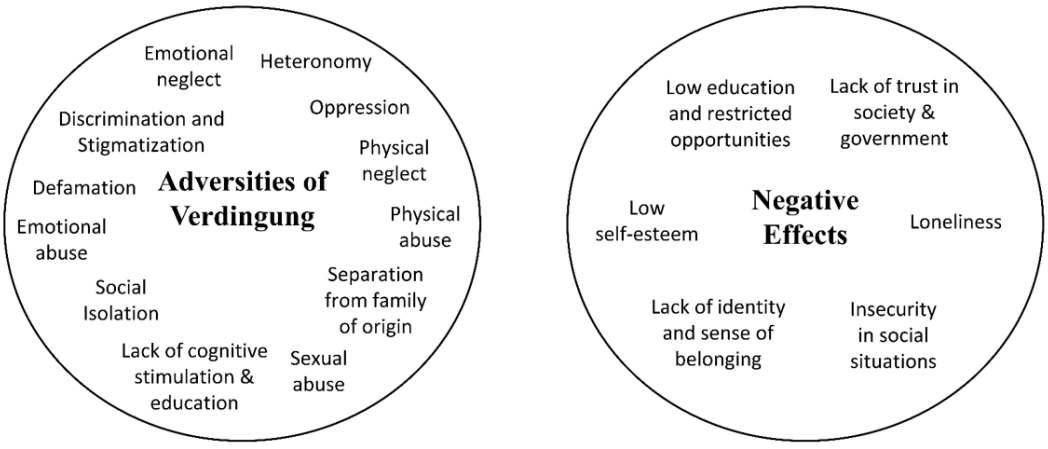
1. The phenomenon: Thriving

Thriving was defined here as positive developments or characteristics which developed as a result of the interaction between the causal and intervening conditions. Statements which were evaluated as socially or morally desired, or that were subjectively reported as advantageous for the participants were coded as indicators of thriving. Two domains of thriving emerged, which will be described in '*the context of thriving*' section.

2. Causal conditions: Adversities of the Verdingung and their negative effects

Causal conditions are necessary but not sufficient for thriving. Two main categories were found (see FIGURE 7).

Figure 7. Main categories and sub-categories of causal conditions.



a) *Adversities of the Verdingung*: The most commonly reported adversities were social isolation, discrimination$_A$, and oppression$_B$. For instance, participants reported that they were often forbidden to visit anyone or to invite other children from school$_b$. In addition, many felt that they were treated as a servant and not part of the family$_C$.

Common physical adversities included physical abuse in the form of beatings and manual labor which was inappropriate for children$_{D}$. All reported experiences of emotional neglect and that they did not feel secure or loved$_{E}$.

Other frequently reported adverse experiences included the lack of cognitive stimulation, further education, or self-fulfillment. The majority of their daily work involved cognitively non-stimulating tasks and many were prevented from attending higher schools$_{G}$.

b) *Negative effects of the Verdingung*: Common negative effects were low education, low self-esteem, and insecurity in social situations. Participants reported that low self-esteem was also a result of the feeling of not being wanted by their own family$_{H,}$ next to their oppression. Feelings of loneliness were often reported in relation to their experienced social isolation as well as an inability to assert themselves$_{I}$. Additionally, a mistrust of society was reported by some as a consequence of the passive behavior of the neighours and governmental institutions.

3. Intervening conditions: Factors supporting thriving during and after the Verdingung

Intervening conditions refer to the resources and factors considered necessary for thriving to occur. Such resources/factors needed to protect against adversities and negative effects, and/or involved adaptive methods of coping.

a) *Factors supporting thriving <u>during</u> the Verdingung*: A common internal resource was the 'motivation' to stay strong, be a good scholar, not to become resigned, and having the will to show that they were worth something. Another commonly reported internal resource was 'personality traits', such as inner strength, which helped participants get through their time$_{J}$.

A common external resource was 'social support' provided by teachers or school physicians, but mainly happened during the participants worst times$_{K}$.

In addition, most participants reported using individual 'coping strategies' to deal with the adversities. For example, one participant reported piecing together shreds of newspaper

which were used as toilet paper so that he could read and compensate for the lack of literature and education provided.

b) *Factors supporting thriving <u>after</u> the Verdingung*: 'Motivation' was found to overlap from the time during and after the Verdingung and remained important for many throughout their life, especially with regard to achieve something, to be of value and self-improvement$_{L}$.

The external factor 'turning points' describes experiences which helped participants to dissociate from their time as a Verdingkind. Not all participants were able to experience a good life immediately after their Verdingung$_{M}$. An important turning point for many participants was being able to move away from where they lived as a Verdingkind$_{N}$.

'Cognition' was an important internal resource/factor, which refers to how participants think about what happened to them and the consequences. Some participants found reflection helpful in recognizing that what happened to them was bad and that to be better it was important not to behave the same way$_{O}$.

Another internal resource/factor identified was 'processing' which relates to actions that helped participants to come to terms with their past and avoid becoming trapped in the negativity of these experiences such as seeking professional help, reading or writing books, painting, social disclosure, or even renovating a house$_{P}$.

Having an 'internal locus of control' was also identified as an important internal resource. Some participants stated that it was crucial to feel in control and responsible for your own life in order to move on$_{Q}$.

4. The context of thriving

Context refers to the domains within which the phenomenon (thriving) is expressed and characterized.

a) *Divergent development* refers to the positive developments and characteristics of participants which are contrary to the experiences of the Verdingung. The participants reported

the belief that a good life should include many positive experiences, the opposite of what they themselves experienced during the Verdingung. Many participants made the conscious decision to have a positive attitude towards life in the future$_R$. Additionally, an 'attitude' expressed by all participants was that children should always be loved and protected$_S$. 'Social-mindedness' refers to the common tendency to care for other people and to live in harmony with others. This is seen as divergent thriving as many reported frequent social conflicts during their Verdingung and feeling as though no one cared for them$_T$. Finally, 'personal responsibility' refers to the high value placed on personal well-being and ability to take care of themselves after their Verdingung. This was stated to emerge from the wretched living conditions and lack of freedom experienced by the Verdingkinder$_U$.

b) Convergent development refers to the positive developments and characteristics of the participants as a result of their experiences during the Verdingung. First, the particpants reported the feeling that they could withstand any hardship because of the experienced hardships$_V$. Second, they transfered and used coping strategies in later life which were developed during the Verdingung. For instance, many transferred the coping strategy of consciously weighing the pros and cons of any behavior into later life, not only to avoid negative consequences, but as a general life strategy for decision-making$_W$. Third, in contrast to 'divergent attitudes', a 'convergent attitude' incorporates the negative experiences in shaping their perspective. For instance, due to their experience that life goes on despite negative events, many reported the attitude that there was no point in stressing about events outside their control, only improving what they could control$_X$.

5. Actions and Interactional strategies: Positive behaviors in life after the Verdingung

This category refers to the commonly reported behaviors in the time after the Verdingung, through which thriving was expressed. The sub-categories represent the positive

behaviours to improve their own lives (career advancement and further education), as well as the lives of others (volunteering, awareness-raising).

Career advancement and further education refers to the pursuit of work or apprenticeships. Participants often tried multiple jobs and many completed voluntary further education[Y]. 'Volunteering' was reported as an important behavior with regard to social engagement and helping others[Z]. Finally, 'awareness-raising' refers to actions carried out by participants to raise awareness of their experiences and to prevent similar situations in the future.

6. Consequences (of thriving)

Three encompassing 'factors associated with successful aging' were identified: *lightheartedness*, *social purpose*, and *self-enhancement*. These factors will be discussed in more detail in the following section with regard to their influence on successful aging.

Conclusions

Aging is a lifelong process. Accordingly, experiences and developments in early-life may provide a foundation for (successful) aging. It was therefore the aim of this study to investigate factors associated with successful aging and to explore how they can develop through adverse experiences in childhood and adolescence. Interviews were conducted with twelve successfully aging, former indentured childhood laborers (Verdingkinder). Three factors associated with their successful aging emerged: *lightheartedness*, *social purpose*, and *self-enhancement*.

Lightheartedness refers to have a positive perspective of life whilst being realistic, combined with effective stress-management. Many reported having a positive attitude towards life in that they view life as valuable and something to be enjoyed, similar to the posttraumatic growth domain 'appreciation of life'[8]. However, due to their negative childhood experiences, they also held the realistic view that adversity is a normal part of life, something which can be

learned from. This is closely related to realistic optimism, which has been shown to be a major contributor to well-being.[25]

Effective stress-management was demonstrated by the ability to use effective coping strategies, as well as a general resilience which developed as a result of their early-life adversity.[5] This was seen in participants who felt they could endure any future hardship or stress due to their experiences as a Verdingkind, which is similar to the posttraumatic growth domain of 'personal strength'.[8] Furthermore, some applied their developed proactive coping skills during their Verdingung in later life, an important predictor of successful aging as it preserves important resources for later in life.[26]

Social purpose is defined by a high value on social relationships, and a desire to live in harmony with and help others, which parallels the posttraumatic growth domain 'importance of social relationships'.[8] Due to the experienced lack of care, attachment, and security, participants felt the need to provide a better life for others. Such behaviors are related to altruism, a strong predictor of well-being, health, and longevity.[27] In addition, the definition of successful aging suggests that these societal-level behaviours are a principal component of successful aging.[2]

Self-enhancement refers to the willingness to learn and explore, and openness to new experiences, similar to the posttraumatic growth domain 'seeing new possibilities'.[8] As a result of the cognitive understimulation, limited education, and lack of self-fulfillment during their childhood, many were motivated to engage in opportunities for self-improvement in later life. In addition to an increased sense of self-efficacy and worthiness expressed by participants, lifelong learning and the associated social contact has been shown to have a positive effect on health into old age.[28]

The final aim was to investigate the mechanisms and factors that underpin the relationship between the negative experiences of the Verdingung, thriving and successful aging. First, before the experience of prolonged adversity a certain level of resilience appears to be

required.[29,30] This was reflected in the current study as the will to survive or endure hardship, and not become resigned during the Verdingung. This result is in line with the conservation of resources theory[31] which predicts the most positive effects in response to adversity for individuals with the highest resilience. Second, the cognitive process of reflection was important in dealing with past experiences and learning from them in order to deal with future events. Previous research has identified similar cognitive processing abilities such as re-evaluation as an important predictor of thriving.[32] Third, motivation was essential in many aspects of health and well-being (i.e. motivation for further education, care of self and others, and refusal to be overcome by adversity). It has been shown that such motivations provide the stimulus necessary to engage in the behaviors that can lead to resilience, and ultimately, successful aging.[33,34] A similar motivation (*planfulness/future motivation*) was previously found as one key factor for change from maladaptive to normative development.[9] Reports on the origin of this motivation in the current study appear to contradict earlier findings. A well-known study of high risk children in Hawaii showed that a role-model can influence the development of such motivation.[35] However, in the current study 'anti-role models' were key to this development, as participants knew who they did not want to become. One similarity to the hawaiian study may be the social support during the Verdingung. Our participants reported rare incidents where they received social support, mostly in extremely bad times. This could have led to the implicit belief that people in need should receive help, leading to the motivation to help others. This adds a rather new perspective to the thriving literature, which focuses on positive effects for the individual and not for others.[19]

Finally, turning points have been previously identified as crucial to initiate thriving.[36] Not all of our participants were able to use the time right after the Verdingung as a "second-chance opportunity".[37] Turning-points which led to social- as well as self-acceptance appeared to be particularly important. It is therefore likely that social support and the society as a whole

would play a central role for the recovery, and ultimately successful aging, of individuals with experiences of adversity, which has also been shown in holocaust survivors.[38]

Limitations and strenghts

A retrospective study design was used which may have led to potential recall and memory biases. This may have influenced participants recall of past childhood experiences and potentially influenced their perception of their current well-being.[39] However, a prospective design would not be ethically possible. Another limitation was the operationalization of 'successful aging' for selection of participants that would have excluded participants with any physical or chronic illnesses.[2] To adjust for this, the current study included psychosocial considerations of health and not only the incidence of disease. There is also a lack of a comparison group of 'unsuccessful agers'. However, given the innovative nature of this approach, we needed to look at an homogenous group of individuals with similar aversive experiences and comparable levels of successful aging. In a next step, it is necessary to test this initial model with 'unsuccessfully' aging survivors. Furthermore, while the population is unique, the adverse experiences reported are common in other populations, such as holocaust survivors or survivors of abuse.

Despite these limitations, the findings extend previous research on adverse childhood experiences, especially indentured childhood labor, and their outcomes in later life. It provides an in-depth examination of thriving and successful aging following experiences of childhood adversity.

Future research

Motivation and reflection were identified as important mechanisms underpinning thriving and successful aging in the current study. Future research should investigate the ways in which to develop these resources. Additionally, the importance of 'anti-role models' is a novel finding. Future research should investigate this with different populations. Furthermore, a more encompassing definition of aging than successful aging should be used. For example,

'healthy aging' as defined by the World Health Organization refers to the functionality of resources that are of value to the goals of the individual.[1] Finally, our study does not imply that thriving in response to early-life adversity is normative and relies mainly on personal factors. Thriving relies on the presence of internal and external factors. This parallels past research that highlights the importance of a supportive environment and also considering the context-sensitivity of such factors.[40] Also, other quantitative factors have to be considered, such as the influence of the frequency, duration and severity of adversity.[12]

Concluding remarks

Former *Verdingkinder* experienced various adversities over prolonged periods of their childhood and adolescence, yet a subgroup could be considered successful agers. This study shows that factors associated with successful aging can develop through adverse experiences. Although inherently a negative experience, adversity can, under particular circumstances, also provide the opportunity for thriving. As a certain amount of adversity is an inevitable part of life, understanding the mechanisms which lead to thriving could allow for public health interventions to increase the likelihood of successful aging.

Online supplement: *Translated* and original Swiss-German quotes from the interviews

A. 1 '*The sentence* '*your're nothing, you're incapable, you won't be anything'...I think that is the worst you can possibly say to a child*'

A. 1 „dä Satz „du bisch nüt, du chasch nüt, us dir wird nie öppis" …das isch gloub eifach s'schlimmste womer wohrschinlich ame Chind cha sägä."

A. 2 '*Everything was so unloving, yes and a lot of harassment*'

A. 2 „Es isch alles eso lieblos gsi, ja und ebä mit viel Schigganä"

B. 1 '*The will is broken for twenty years. Always is the will broken*.'

B. 1 „Zwanzig Jahre lang immer wird der Wille gebrochen. Immer wird der Wille gebrochen"

B. 2 '*As a Verdingkind you were always a bit submissive and always had to obey and always had to do what the others say.*'

B. 2 „Als Verdingchind bisch ja du ächli immer chli unterwürfig gsi und hesch immer müssä pariärä und immer müssä losä, was diä andärä sagä"

C. 1 '*I was never able to make any friends in childhood or adolescence ... I was not even allowed to leave the house*'

C. 1 „ich han nienäh chönä ähm Chinder- u Jugendfründschaftä ufbouä … i ha ned emal vom Huus äwäg dörfä"

C. 2 '*...a feeling of not being welcome, of deportation… a feeling that no one needs you*'

C. 2 „…äs Gfühl vo unwillkomme, wo vo Abschiebä …es Gfüoul vo es würd di eigentlich gar ned bruchä"

D. 1 '*For every nonsense that he [brother] did, I was beaten or was locked into the basement.* '

D. 1 „Für jeden Blödsinn, der der [Bruder] gemacht hat, habe ich wieder Schläge bekommen oder wurde in den Keller gesperrt"

D. 2 '*And if you did not obey, they smacked you. That is how it was*.'

D. 2 „Und wennd nöd pariert hesch, hesch uf de Ranze übercho, oder. So ischs gange

E. 1‘*...but I never felt love, no one ever hugged me, or said that you’ve done something right, or that no one talked to me for several days, that is also violence.*’

E. 1„…Aber das ich kei Liebi, dass ich nie in Arm gnoh wordä bi, oder gseit du hesch das guät gmacht, oder dass mer tagelang a mich anägschwiegä hät, das isch au Gwalt.”

F. 1 ‘*But a choice of what you want to work, how you probably experienced it, we didn’t experience that, nobody took care of us. Neither the teacher, and for sure nor the foster parents.*’

F. 1 „Aber Bruefswahl, so wie ihr das wohrschinlich erlebt heit, das hei mir det nid kennt, do hät sich kei Mensch um das kümmeret. Dä Lehrer doch nid, die Pflegeltere scho grad gar nid. ”

G. 1 ‘*...for sure I could have made more out of myself. If someone would have promoted me. But that wasn’t what they had in mind. I only had to function*’

G. 1 „…hät ich sicher öbis äh meh chönä usähole us mir. Wenn mer mich gfördert hät. Aber das isch ja nöd im Sinn vo dänä gsi früener. Das isch du hesch eifach müssä funktioniärä.”

H. 1 ‘…*I had to build up this trust [in myself] by myself. The lack of self-esteem, I felt this for a long long long time*’

H. 1 „…s’Vertraue han ich möse bi mir sälber ufbaue, das hät mich dä Mangel, dä Mangel an, an Selbstvertraue, das han ich lang lang lang gspürt”

I. 1 ‘*...I cannot really defend myself. I have never learned that*’

I. 1 „… ich chan mich eigentlich nöd würklich guät wehrä. Ich han das au nöd glärnt”

J. 1‘*...I resisted so that I didn‘t surrender to this. And I did it and that’s why I probably have it better today…*’

J. 1 „…ich han mich gwehrt, dass ich nid undergo i däm. Und ich has gschaffet und

drum han ichs wahrschindli hüt besser…"

J. 2 '*...If you would have already been weak at that time, than you would have been broken and couldn't have withstood it. I can imagine, that many couldn't stand it*'

J. 2 „…Wenns ja döt dazämal scho schwach gsi wärsch oder das ned da häts wärsch ja zerbrochä und hättsch das gar nöd ertrait. Chönd sich ämäl vorstellä, dass vieli das nöd ertrait händ."

J. 3 '*That I have the power, that I can show them that I won't perish*.'

J. 3 „Dass ich diä Chraft ha, däne cha bewiese, dass es, dass ich nid undergoh. "

K. 1 '*I always had persons who helped me when it was really important.*'

K. 1 „ich han au immer Lüüt gha wenns würklich wichtig gsi isch wommer ghulfe hend."

K. 2 '*…a kindergarten teacher somehow recognized it, that something is wrong. And then I got away from there*'

K. 2 „eine Kindergärtnerin hat das irgendwie dann gemerkt, dass da etwas nicht stimmt. Und dann wurde ich dort weggenommen. "

K. 3 '*the school physician,… he was my angel*.'

K. 3 „dä Schuelarzt, …, und das isch mi Engel gsi"

L. 1 '*...because of what I had to experience during my adolescence, I had the drive to achieve something in my life*'

L. 1 „…dur das was i dä Jugend erläbt ha hetsmer eifach dä Drang geh sassi öbis wott erreichä im Läbä."

L. 2 '*...I was always learning. It's crazy and I loved it. That's maybe how to stay fit, remain longer fit*'

L. 2 „…ich bin ständig am lerne gsi. Es isch wahnsinnig und das han ich super gfunde. So isch me viellich ou echli fit, länger fit bliebe."

L. 3 '*I never liked to stay in one place for a long time. I always wanted to do something*

new.'

L. 3 „Ich eigentli nie lang gärn amene Ort gsi. Ich ha gern immer wieder öbis neus gmacht."

L. 4 '*I wanted to show that I can do it better than the things that I had to experience.*'

L. 4 „Han welä zeigä dass ichs besser cha machä weder dass mers mit mir gmacht het."

M. 1 '*Maybe I'd done a burglary. At the beginning [after the end of the Verdingung], all the hate and frustration against all people… I could have robbed a bank… I'm very certain, if [TV show] hadn't happened, I really have to say, I would have become a criminal.*'

M. 1 „Het viellicht Ibrüch gmacht, weisses nöd… Am Afang dä ganz Hass und dä Frust gäg all Lüt, oder… Aber ich hett sicher irgendwiä än Bank… ich wär ganz sicher, wänns [TV show] nöd gsi wär, mussi hüt ehrlich säge, wär ich i di kriminelli Laufbahn…"

M. 2 '*I was in something like a vaccum. I remember, when I was younger, when I had a child, I was very anxious. Do I make it right or does my child have to experience the same as I did. That was very bad. But after a while I recognized, that it is not so bad. I can change it. And that was my luck.*'

M. 2 „Me isch denn so wiä imene Vakuum inne gsi. Ich weiss, wo ich jünger gsi bi, won ich d Chind gha han, dä isch eso diä riesä Angst gsi. Mach ichs richtig oder müsse mini Chind das o erläbe. Das isch ganz schlimm gsi. Aber irgendwänn hani gmerkt, dass isch ja gar nöd schlimm. Ich chas jo ändere. Und das isch mis Glück gsi."

N. 1 '*God I'm so happy that I don't have to live there anymore… [it] was a relief for me… I was no Verdingkind there anymore. And I think that would have been very good for many, if they could have gotten away from there.*'

N. 1 „Mein Gott bini froh, mussi nüm da läbe… Züri isch bi mir Befreiig gsi... Ich bi ke,

do bin ich kes Verdingchind meh gsi. Aber solang ich det i der Region bi gsi ... Det bin ich bis zwänzgi es Verdingchind gsi… Und das, ich dänk das wär für vieli guet gsi, wenn sie hätte chöne vo dänne sich löse, vo dem Ort und wäg."

O. 1 '*...First, I had to understand that these patterns were mad and had to be breached somehow, otherwise you cannot go on or just waste away…*'

O. 1 „…das hani jo zersch müesse mitübercho dass u das si so Muster verruckti wo mer när wos wichtig isch das mer se mau irgendwie dürbricht susch chunt mer ja nid witer oder verchümmeret…"

P. 1 '*You have to work on yourself, so that you won't get as brutal*'

P. 1 „muesch scho a dir schaffe, dass nid au so äää au so brutal wirsch"

P. 2 '*The therapist was wonderful, he gave me a tennis racket and a beanbag and I remember that I could not move my right shulder for a whole week. I've beaten that bag so hard and that was a very good sign for me, that it is not enough to do this with my thoughts, but also to let it out of my body. The beatings I had to experience had to get out and I was able to direct my anger to that person...*'

P. 2 „de Therapeut isch eifach wunderbar gsi, aso de hät mir Tennisschläger id Hand gä, ä stabile Sitzsack und ich weiss ich ha döt e wuchelang mi rechti Dings nüme chöne bewege, d'Schultere. Ich ha so uf de Sack iprätscht und das isch aifoch für mich e sehr e guets Zeiche gsi, das mues nit nur mine Gedanke bim rede, es mues au öppis vom Körper use. Au die Schläg wo ine cho sind, wo mir abbecho händ, da mues jetzt eifach use und ich has döt au chöne richtig uf die Person wonich jetzt die Wuet ha…"

Q. 1 '*...every human is responsible for his/her own life… in every situation and everything you experience… Otherwise you'll never get out of it*.'

Q. 1 „…jedä Mensch sälber verantwortlich isch für sis Läbä… du chasch ned jederä

Situation und alles was du erläbsch... Susch chunsch du gar ned drus usem Ding us."

R. 1 '*...I'm thankful for the strength I have that I can always see life positively… I learned to live consciously and have fun every day*'

R. 1 „…bin ich dankbar für diä Chraft won ich han dass ich immär wiedär s Läbä positiv gseh ha... han ich glärnt bewusst läbä und Freud ha und jedä Tag"

S. 1 '*...my own children… they must never no matter under which circumstances, they must never live like I had to. It's maybe because, yes, normal. That it is in contrast… it goes back to what I experienced, I don't pass this on. I will do the opposite if possible.*'

S. 1 „…mini eigene Chind … diär müesst niä egal unter welnä Umstände, diär müesst niä so wiän i ha müesse. Isch viellicht ou, ja, normal. Dassmer das z konträr… Ebe chunt wieder zrugg uf das, was i erläbt ha, gibeni nid witer. I wett nach Möglichkeit s Gägeteil mache. Drum ou niä schlah, niä…"

T. 1 '*I developed a social consciousness in that time… the Verdingung influenced my humanity for my future life. Because again derived from that, I wanted to pass on what I missed*'

T. 1 „Ä soziali Aderä hani i därä Ziit entwickled… die Verdingziit het im witerä Lebesverlauf äbä än Ifluss gha uf di Humanität... Äbä da vo däm wieder abgleitet i het au das gern wouä witergäh woni selber vermisst ha"

U. 1 '*So I believe it* [*the Verdingung*] *formed me in a way. That I looked out for myself... So to look for myself, if no one else is doing it then, this is an imprinting throughout my whole life*'

U. 1 „Also i glaub insofern häts mi scho prägt. Das ich eifoch mich aso halt meh für mich gluegt ha… Aso uf mich selber luege, wenn scho niemer ander luegt denn, das isch scho au ä Prägig durch mis ganzä läbä"

V. 1 '*…it gave me a strong back for later life… And don't become damaged for the rest of your life because of this gives you an armor for future life… So it strengthened me*'

V. 1 „…das het dir eigentlich scho no ä breitä Ruggä gäh fürs Läbä… Und dadurch ned grossä Schadä z becho isch eigentlich scho ä Rüstig fürs zuäkünftigä Läbä… Unds ich bin das het mich gstärkt"

V. 2 '*No tough horse can distract me from my goals*'

V. 2 „Keini zäh Ross bringe mi meh vo mim Ziel ab."

W. 1 '*I always questioned everything. What happens, when I do this and that and when I don't do it. What consequences it has. And this might also be present in today's thinking, it helps me*'

W. 1 „Also ich ha mich eifach immer alles hinterfrogt. Wa passiert, wenni jetzt das und das mach und wenn is nid mach. Was häts für Konsequenze. Und do isch viellich au hüt im hütige Denke, hät mir das eifach au ghulfe."

X. 1 '*This is my motto… Based in my childhood. Yes, that everything doesn't go the way you want it to… When there is no way, you just have to search for another way, there is always a way*'

X. 1 „Das isch efach mis Motto… Vo de Chindheit her. Ja, das ned eifach alles gaht wie du wotsch… Wens ned witergaht, muesch eifach en andere Weg sueche, es gaht immer en Weg"

X. 2 '*I always say, why should one hyperventilate, it is what it is, we have to see when it happens what we do. And this is how I see my life. I always say* '*the soup is not eaten as hot as it is cooked*'

X. 2 „i säg aubä, was weimer go hyperphentiliere, es isch wies isch, oder, mir müesse de luege wenns de so wit isch, was mer demit mache und so gsehni halt mis Lebe. i säg aubä d'Suppe wird nid so heiss gesse, wie sie kochet wird"

Y. 1 '*...I always recognized that working isn't enough for me, I always did an extra seminar or a further education just because of curiosity…*'

Y. 1 „…hani immer o gmerkt dass de schaffe das längt mir nid, i ha immer no öpis näbedranne irgend ä Kurs oder e Witerbiudig hani de scho eif haut us Neugierd... "

Z. 1 '*...I cook for students. I've also been to a retirement home for a long time… visited old people for talking and driving around with them. Now I'm at the food bank…*'

Z. 1 „…ich han denn no für Studäntä tueni chochä. Dänn hani lang a- bini z O. inän Altersheim no gangä… alti Lüüt go bsuechä go schwätze chli umäfahrä mit dänä. Dänn bini jetzt bidä Tafälä…"

Z. 2 'So when I see that someone is not right, I help. I visit old people around my neighborhood. They always say that it is so sad that I leave. We help each other out in our neighborhood, I started this, just wenn someone is sick. '

Z. 2 „Also es isch denn wenn ich merke es geit öppere schlecht, denn tueni ou hälfe. Ich tue, ich go alti Lüt bsueche oder mir hei ou do obe. Sie säge immer es isch so schad, dass du furt geisch. Mir hei do, so diä Hüser, mer tü enand hälfe das han ich agfange eifach wenn öper chrank isch."

Online supplement: Verdingkinder

Today, an estimated 10,000-20,000 former Verdingkinder are still living[1]. Verdingkinder, refers to Swiss former indentured child laborers, known for their adverse living conditions as children and adolescents.[2] State officials took these children from their homes in most cases against the will of their parents and placed them with farmers or craftsmen where they were expected to work for food and accommodation, without pay, sometimes until 20 years of age. In some cases, the parents even had to pay the foster families for housing their children.[2] This system started at a time when Switzerland was poor and farming was still mechanistic. Thus, cheap laborers were required and found in the form of the children of poor families. While this was the first and main reason for the government to introduce this system, children were later removed from their families for other reasons, such as single parenthood, unmarried mothers, or maltreatment or drug abuse in the family.[2]

At their new homes, they were often denied food or a school education, were sexually, emotionally, and physically abused and neglected, and lived in social isolation.[3] They were also often stigmatized for being a so-called *Verdingkind*. They were seen as belonging to the lowest class and were maltreated by others. After the end of their childhood labor, they did not receive any compensation from the state. While it is unclear how many children faced this fate, numbers range in the several hundred-thousands.[2] This dark chapter of Swiss history lasted from around 1850 until 1981. However, whilst severe, the adversities experienced by former

8.2 Curriculum Vitae

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EDUCATION

03/2017 – ongoing	**Training** in Logotherapy and Existential Analysis, Fuerstenfeldbruck, Germany
01/2017 – 03/2018	**Certificate of Advanced Studies in University Teaching**, University of Zurich, Switzerland.
12/2015 – ongoing	**PhD program** *LIFE* of the International Max Planck Research School on the Life Course. Participating institutions: MPI for Human Development, Humboldt-University of Berlin; Free University Berlin; University of Michigan; University of Virginia; University of Zurich
09/2015 – ongoing	**PhD Student** at the University of Zurich, Switzerland Psychopathology and Clinical Intervention University Research Priority Program 'Dynamics of Healthy Aging' Advisors: Prof. Dr. Dr. Andreas Maercker, Prof. Dr. Ulrike Ehlert PhD thesis: *Salutogenic effects of adversity and the role of adversity for successful aging*
10/2009 – 11/2014	**Magister of Science in Psychology** (Mag. rer. nat.), University of Vienna, Austria; passed with distinction Major: Social Psychology, Clinical & Health Psychology, Environmental Psychology

	Master's thesis at the chair of General Psychology: *NatureWork – the workplace as a natural landscape* Advisor: Prof. Dr. Rainer Maderthaner

ACADEMIC POSITIONS

09/2015 – ongoing	**PhD researcher**, Psychopathology and Clinical Intervention, University Research Priority Program 'Dynamics of Healthy Aging', University of Zurich, Switzerland (Chair of Prof. Dr. Dr. Andreas Maercker)
06/2015 – 08/2015	**Research Assistant**, Work and Organizational Psychology, University of Zurich, Switzerland (Chair of Prof. Dr. Martin Kleinmann)
09/2012 – 01/2015	**Research Assistant**, Public Health – Environmental Psychology, Medical University of Vienna, Vienna, Austria (Supervisor: Prof. Dr. Renate Cervinka)

ACADEMIC TEACHING

Spring 2016, 2017, 2018	**Inter-disciplinary bachelor seminar** "Gender and Psychopathology", University of Zurich, Switzerland
2013 – 2014	**Master seminar** "Environmental Psychology", Medical University of Vienna, Austria

SUPERVISION OF JUNIOR RESEARCHERS

Master theses, 2016-2018	Alexandra Marasco, Katharina Szybalski, Yasmine Greiveldinger, Délia Revelly, Pascal Kohler, Florin Bösch
Bachelor theses, 2016-2018	Antonia Koller, Teresa Münch Cobos, Mara Huber, Sanara Luchsinger
Interns, 2016-2018	Vera Giulia Meier, Lisa Walther, Raphael Zeltner, Mandy Fong, Veronica Tommasini, Jana Häberlin, Orlando Lüscher, Tracy Wagner, Zoe Hillmann, Simona Brühwiler, Viviane Dürst, Janine Gebser, Flavio Iovoli

ACTIVITIES IN PANELS, BOARDS

2017	**Speaker** of the Zurich LIFE fellows

PRIZES, AWARDS, GRANTS

02/2018	**Travel Grant** by the PhD Office of the Psychological Institute, University of Zurich, Switzerland, CHF 1‘000
01/2018	**Student scholarship** for attending the 20th Conference of the German-speaking Society of Psycho-Traumatology, CHF 140
07/2017	**Co-recipient of grant for a workshop** on Open Science by a Joint Seed Funding of the Free University of Berlin, Germany, and the University of Zurich, Switzerland, CHF 2‘726
06/2017	**Travel Grant** by the Philosophical Faculty, University of Zurich, Switzerland, CHF 1‘216.98
02/2017	**Travel Grant** by the PhD Office of the Psychological Institute, University of Zurich, Switzerland, CHF 1‘000
01/2017	**Student scholarship** for attending the 19th Conference of the German-speaking Society of Psycho-Traumatology and 22nd Zurich Psycho-Traumatology Conference, CHF 180
04/2016	**Research grant** by the Jacobs Foundation, CHF 10‘000

CLINICAL EXPERIENCE

07/2012 – 08/2012	Internship at the Origo Health Centers, Vienna, Austria
2014 – 2015	Volunteer at Pro Mente (Social Psychiatry), Vienna, Austria

PUBLICATIONS IN PEER-REVIEWED SCIENTIFIC JOURNALS

Höltge, J., Mc Gee, S.L., Maercker, A., & Thoma, M.V. (accepted). A salutogenic perspective on adverse experiences: The curvilinear relationship of adversity and well-being. *European Journal of Health Psychology*. doi: 10.1027/2512-8442/a000011

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Pirgie, L., Schwab, M., Sudkamp, J., Höltge, J., & Cervinka, R. (2016). Recreation in the national park – visiting restorative places in the National Park Thayatal, Austria fosters connectedness and mindfulness. *Zeitschrift Umweltpsychology*, *20*(2), 59-74.

Haluza, D., Simic, S., Höltge, J., Cervinka, R., & Moshammer, H. (2016). Gender aspects of recreational sun-protective behavior: results of a representative, population-based survey among Austrian residents. *Photodermatology, photoimmunology & photomedicine*, *32*(1), 11-21. doi: 10.1111/phpp.12213

Haluza, D., Simic, S., Höltge, J., Cervinka, R., & Moshammer, H. (2014). Connectedness to Nature and Public (Skin) Health Perspectives: Results of a Representative, Population-Based Survey among Austrian Residents. *International journal of environmental research and public health*, *11*(1), 1176-1191. doi: 10.3390/ijerph110101176

PEER-REVIEWED CONFERENCE ABSTRACTS

Hoeltge, J., Pirgie, L., Sudkamp, J. & Cervinka, R. (2014). Predictors of Perceived Restorativeness in Private Gardens. *In Transitions to sustainable societies: Designing research and policies for changing lifestyles and communities*. Timisoara, RO: International Society for People-Environment Studies.

Schwab, M., Hoeltge, J., Pirgie, L., Sudkamp, J., & Cervinka, R. (2014). My garden as a power plant for health? Private Gardens, perceived restorativeness and self-reported health. In *Transitions to sustainable societies: Designing research and policies for changing lifestyles and communities*. Timisoara, RO: International Society for People-Environment Studies.

Sudkamp, J., Pirgie, L., Höltge, J., Schwab, M., & Cervinka, R. (2014). Green Care Forest: Searching for empirical evidence. In *Transitions to sustainable societies: Designing research and policies for changing lifestyles and communities*. Timisoara, RO: International Society for People-Environment Studies.

Pirgie, L., Höltge, J., Sudkamp, J., Schwab, J., & Cervinka, R. (2014). Restoration and sustainable development: The case study National Park Thayatal/Austria. In *Transitions to sustainable societies: Designing research and policies for changing lifestyles and communities*. Timisoara, RO: International Society for People-Environment Studies.

ORAL CONTRIBUTIONS TO CONFERENCES

Talks

Höltge, J., Mc Gee, S.L., Maercker, A., & Thoma, M.V. (2018, May). [*Can adversities in childhood and later life positively influence aging?*] Presentation conducted at the '[36th Symposium of the Section of Clinical Psychology and Psychotherapy of the German Society of Psychology]', Landau, D.

Höltge, J., Maercker, A., & Thoma, M.V. (2017, September). *A qualitative study on the potential positive effects of childhood adversity and associated conditional factors of former 'Verdingkinder'*. Presentation conducted at the "15th SPS SGP SSP Conference: Treasuring the Diversity of Psychology", Lausanne, CH.

Mc Gee, S.L., Höltge, J., Maercker, A., & Thoma, M.V. (2017, June). *Validation of the Sense of Coherence-Revised Scale: Psychological health in older adults with varying experiences of childhood adversity*. Paper presented at The 15th European Conference on Traumatic Stress: Child Maltreatment across the Lifespan, Odense, Denmark.

Höltge, J. (2017, May). *Thriving in response to childhood adversity: A qualitative study*. Presentation conducted at the LIFE Spring Academy of the International Max Planck Research School on the Life Course, Ann Arbor, USA.

Höltge, J. (2017, February). [*Being healthy in higher age despite indentured childhood laboring: A qualitative analysis of potential salutogenic processes*]. In M. Thoma & J. Höltge (Chair), [Positive effects of adverse experiences]. Symposium conducted at the '[19th annual conference of the German-speaking Society for Psycho-Traumatology]' and '[22nd Zurich Psycho-Traumatology meeting]', Zurich, CH.

Höltge, J. (2016, October). *A systematic review on the curvilinear relationship of adversity and thriving*. Presentation conducted at the LIFE Autumn Academy of the International Max Planck Research School on the Life Course, Berlin, D.

Thoma, M.V., Höltge, J., & Maercker, A. (2016, September). *Determinants, conditions and mechanisms influencing personal thriving after the experience of adversity: A systematic review*. Presentation conducted at the '[50th conference of the German Psychological Society]', Leipzig, D.

Höltge, J., Schweizer-Ries, P., Sudkamp, J., Pirgie, L., Schwab, M., & Cervinka, R. (2014, June). *Let sustainability happen. Approaching sustainable development via perceived restorativeness at the Campus*

of the Bochum University of Applied Sciences, Germany. In R. Cervinka & P. Schweizer-Ries (Chair), Walking the Path of Integrated Sustainability: Experience the Restorative, Interactive and Physical Dynamics of Place. The Case Study of Bochum University. Symposium conducted at the conference of the International Association of People-Environment Studies, Timisoara, RO.

Poster presentations

Höltge, J., Maercker, A., & Thoma, M.V. (2018, March). [*Can adverse experiences in later life increase resilience and therefore exert a protective effect on the aging process?*] Poster presented at the '[20th Annual Conference of the German-Speaking Society of Psycho-Traumatology]', Dresden, Germany.

Höltge, J., Mc Gee, S.L., Maercker, A., & Thoma, M.V. (2017, November). *Healthy Aging Despite The Odds: Can Adversity in Higher Age Improve Essential Resources of Adaptability? A Longitudinal Study*. Poster presented at the University Research Priority Program 'Dynamics of Healthy Aging' In-house conference, Ittingen, CH.

Thoma, M.V, Höltge, J., Mc Gee, S.L., & Maercker, A. (2017, November). *Healthy aging despite the odds: A qualitative study on thriving in response to childhood adversity and healthy aging: The case of former Verdingkinder*. Poster presented at the University Research Priority Program 'Dynamics of Healthy Aging' In-house conference, Ittingen, CH.

Mc Gee, S.L., Höltge, J., Maercker, A., & Thoma, M.V. (2017, November). *Healthy aging despite the odds: The role of mediating and moderating factors in healthy aging following early-life adversity*. Poster presented at the University Research Priority Program 'Dynamics of Healthy Aging' In-house Conference, Ittingen, CH.

Höltge, J., Mc Gee, S.L., & Thoma, M.V. (2017, October). *The Curvilinear Relationship of Early-Life Adversity and Successful Aging: The Mediating Role of Mental Health*. Poster presented at the LIFE Autumn Academy of the International Max Planck Research School on the Life Course, Zurich, CH.

Höltge, J. (2016, May). *Determinants and mechanisms of thriving: a systematic review*. Poster presented at the LIFE Spring Academy of the International Max Planck Research School on the Life Course, Charlottesville, USA.

Höltge, J., Maercker, A., Marasco, A., Revelly, D., & Thoma, M.V. (2017, April). *Can harsh living conditions in childhood have beneficial effects on health in higher ages? A qualitative approach*. Poster presented at the 4th International Conference Aging and Cognition, Zurich, CH.

Mc Gee, S. L., Höltge, J., Maercker, A., & Thoma, M. V. (2017). *The Sense of Coherence-Revised scale: Resilience aspects and psychological health in older adults following childhood adversity*. Poster presented at the "15th SPS SGP SSP Conference: Treasuring the Diversity of Psychology", Lausanne, CH.

OUTREACH ACTIVITES

Bundesforschungszentrum für Wald (2014). *Green Care WALD* [Brochure]. Vienna: BFW. Available at http://bfw.ac.at/rz/bfwcms.web?dok=9816

Cervinka, R., Höltge, J., Pirgie, L., Schwab, M., Sudkamp, J., Haluza, D., Arnberger, A., Eder, R., & Ebenberger, M. (2014). *Zur Gesundheitswirkung von Waldlandschaften* [Green Public Health – Benefits of Woodlands on Human Health and Well-being]. Vienna, Austria: BFW. ISBN 978-3-7001-6098-4

Cervinka, R., Höltge, J., Pirgie, L., Schwab, M., Sudkamp, J., Haluza, D., Arnberger, A., Eder, R., & Ebenberger, M. (2014). *Green Public Health – Benefits of Woodlands on Human Health and Well-being*. Vienna, Austria: BFW. ISBN 978-3-902762-32-0